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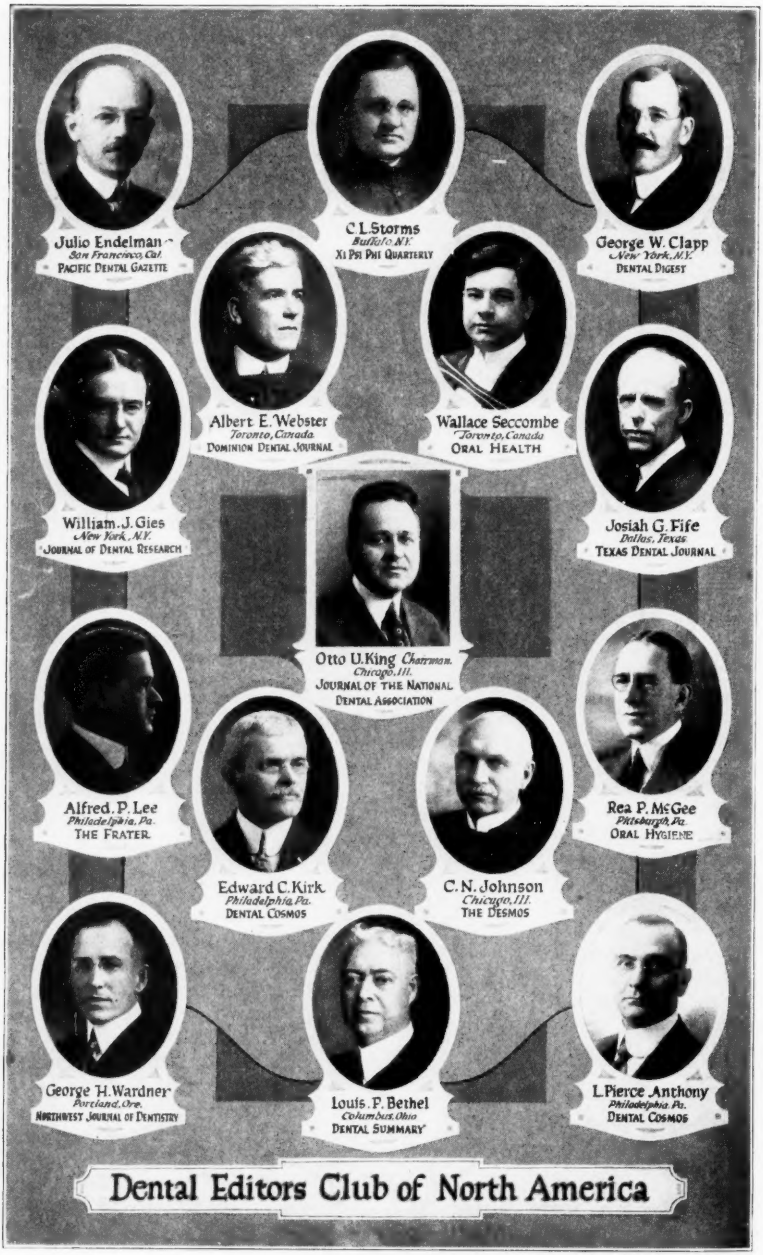
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Original Communications

DISEASES OF THE MOUTH AND GENERAL HEALTH[1]

By THOMAS L. GILMER, M.D., D.D.S., Sc.D., Chicago, Illinois

THE mouth is subject to as great a variety of diseases as any other part of the body, altho their multiplicity and importance are often not fully recognized. I am venturing to invite your attention to some of these affections of the mouth in their relation to diseases elsewhere in the body, in the hope that the discussion may not only prove of interest, but that attention may be directed to some of the problems of the day which await solution, especially that related to the elimination of certain oral conditions of children which may affect their physical and mental well-being thru life. Before adverting to these matters, however, I wish to discuss briefly the relation of disease of the mouth to general disease and to present certain views which, while not entirely in harmony with current opinion, are derived from my own experience.

Diseases of the mouth are either local in character or they may constitute part of the picture of general diseases, the primary lesion of which may be oral or situated elsewhere in the body.

Mucous patches and gumma of syphilis, Koplik spots of measles, the strawberry tongue of scarlet fever, and the petechial spots of purpura hemorrhagica are oral manifestation of general diseased conditions in other parts of the body. Lesions of the kidney, also, are often associated with pathologic changes in the mouth. When albumin is found in the urine of pregnant women, the gums often become hyperemic, swollen, tender and bleed easily on being touched. This condition of the gums disappears soon after parturition. The non-malignant tumor, improperly called epulis, when found in the mouth of pregnant

[1]President's Address, reprinted from the *Proceedings of the Institute of Medicine of Chicago*, 1921.

women, increases in size more rapidly during the later months of pregnancy, and after delivery it decreases to about its former size.

Senile changes are always more or less reflected in the mouth by rapid wasting of the gums. Similar changes are also seen in the mouths of men past middle life who have long been subjected to the strain of business and its attendent cares and anxieties. As a result of destruction of the gums, deep pockets are formed between the teeth in which accumulate debris from wasting tissues, together with food and bacteria. Teeth which have resisted disease up to this time now decay rapidly on surfaces exposed within these pockets.

Secondary and tertiary syphilitic manifestations in the mouth are too well known to require more than passing mention. It is also well known that syphilis may appear primarily in the mouth, and there are a number of oral diseases which are sometimes mistaken for syphilis. Carcinoma of the mouth in its earlier stages has the appearance of syphilis, and indeed is believed in certain cases to develop on the site of previous syphilitic leucoplakia, and to add to the confusion a positive Wassermann reaction may be found. Chronically infiltrated ulcers of the buccal mucosa due to injuries caused by malposed teeth and by teeth having sharp edges are occasionally seen. These ulcers are covered with a grayish-white film which suggests syphilis. Removing or changing the relation of the teeth, or smoothing their sharp edges, brings about a cure. Gonorrheal and chancroidal infections are found in the mouth.

Leucoplakia of the mouth is an interesting disease. Evidently there are two forms. One is transitory, coming on suddenly, and disappearing without treatment; the other does not disappear spontaneously, and generally has a history which indicates that it is of syphilitic origin. Both are white in appearance, but the former is a less intense white, and is more widely distributed over the mucous membrane.

Herpes of the mouth, commonly called canker sores, are frequently seen on the buccal mucosa. They appear suddenly and are extremely painful, and are not infrequently associated with gastro-intestinal disturbances. For some as yet unknown reason women are far more subject to them than are men. Actinomycosis is found in the mouth, and decayed pulpless teeth offer a convenient nidus for its implantation.

Another disease definitely primary in the mouth became prevalent among the soldiers during the world war. It is an infection of the gums known as "trench mouth." Some thought this a new disease, but it had been recognized many years before, and was described in 1906, and named "acute ulcerous gingivitis."[2] Since then it has received many names. Weaver and Tunnicliff call it "ulcero-membranous gingivitis." Later Tunnicliff isolated the predominating organism accompanying this disease for me and found it to be the *Bacillus fusiformis.* This organism is of special interest since it is so often found in various other lesions, and it frequently grows symbiotically with other organisms. Infections starting at the angle of the jaw and extending to the floor of the mouth, causing diffused cellulitis, known as Ludwig's angina, seem to be due to the streptococci, in association with this organism. Prior to the war acute ulcerous gingivitis was rarely seen. After demobilization it was prevalent for a time, having apparently been communicated in many instances by the ex-soldiers to those who had not been in the army. It is now disappearing rapidly.

Dr. Hunter is of the opinion that septic mouths are the cause of what he calls "septic anemia." Glossitis or ulcers of the tongue and mucosa are practically

[2]*Dental Review*, XX (1906), 459.

always present at some time in the course of progressive pernicious anemia.

Neoplasms of the mouth are definitely primary there, and should be considered in this connection. Dr. Partsch has stated that 90 per cent of all neoplasms which affect the jaws belong either to the carcinomas or sarcomas, of which the former comprise 53 per cent and the latter 37 per cent. It would seem that these figures are excessive, especially for the sarcomas, unless they include those benign growths, known as epulis, and the nonmalignant myeloid or giant-celled sarcoma. Epulis is a fibrous connective tissue growth with some of the histologic appearances of giant-celled sarcoma. Epithelioma and the malignant sarcoma are prevalent in the mouth, and the former apparently is becoming more common. Most pathologists believe that chronic mechanical irritation plays an important rôle in the causation of epithelioma, and there is evidence in favor of this belief, but my experience, which may have been unusual, indicates that the importance of mechanical chronic irritation has been overestimated. During the past three years I have seen, in my private practice, twenty-nine cases of epithelioma of the mouth, and of this number only eight might supposedly be attributed to mechanical injury. Nine of the growths were associated with leucoplakia. Twenty-seven of the patients were males and two were females. My clinic histories of patients who had epithelioma are not sufficiently reliable to justify an estimate of the number of these tumors which could be attributed to mechanical injury, or to the frequency of leucoplakia as an accompaniment to them, but I am of the opinion that they do not differ materially from those seen privately. The surgeon may be led astray by the history of these growths given by the patient. He is often told that a certain sharp tooth has caused the disease, but careful examination usually discloses the fact that the primary lesion could not, in its incipiency, have been in contact with the accused tooth. Epithelioma is not usually sensitive in its earlier stages and therefore is not noticed by the patient until the growth has extended beyond its original location. As a result of the increased development of the neoplasm, the tooth later comes in contact with the increasingly inflamed and therefore more sensitive area, and then for the first time it is noticed by the patient, who naturally attributes it to the tooth. If chronic irritation were the most common cause of epithelioma, it would seem that irritation due to nose glasses would result in this disease. I have never known a case of epithelioma which was caused by irritating nose glasses, and ophthalmologists of wide experience have informed me that they also have not known such a case. Evidence is gradually accumulating which seems to indicate that heat is a factor in the cause of cancer—not a sufficient degree to produce burns, but a rather high heat frequently applied.

Sarcoma of the mouth is not uncommon in young people and children and occasionally is seen in the mouths of older persons. The round and spindled-celled varieties in the mouth are very malignant and much inclined to form metastasis, while the giant-celled or myeloid type does not cause metastasis, and in this respect is not of itself malignant; it is, however, very destructive of bone.

Mixed tumors, largely composed of glandular structure, are found in the hard and soft palate. They are always unilaterally placed, encapsulated, and not malignant. Lipoma is found in the cheek; angioma on the lips and gums; and papilloma on the palate and other localities in the mouth. Odontoma and adimantinoma of the jaws are attributed to epithelial rests, from unatrophied parts of the cord of the enamel organ. Retention mucous cysts, in the floor of the mouth, known as ranula, also, muciperous cysts of the lips, cysts of the Bland and Nuhn gland, and dentigerous cysts are an interesting group of tumors

found in the oral cavity. Stones are occasionally found in Wharton's and Stevenson's ducts. Evidence seems to indicate that these calcareous deposits are formed in the salivary glands and are extruded into the ducts, where they enlarge from additions received from the lime of the salivary secretions. Bilateral exostoses are frequently seen on the lingual surfaces of the mandible in the region of the bicuspids. Occasionally they grow to considerable size, extending from the one side toward the other until they nearly meet. A similar growth is seen in the median line of the hard palate. Their removal is rarely indicated.

Tuberculosis is generally supposed to be secondary in the mouth, due to an extension of the disease from lupus on the face or lips, or from tuberculosis of the lungs. I have seen several cases in which tuberculosis seemed to be definitely primary in the mouth. In two of these the disease had attacked the tongue. There was a soft ulcerated area with ragged undermined margins, and a surface coating of a grayish-white layer. These ulcers are extremely tender, and in this respect differ from carcinoma. Multiple miliary tuberculosis is occasionally found in the mouth, studding the surface of the buccal mucosa.

The physician's interest in diseases of the mouth was increased when our own Dr. Billings, Dr. Hunter of England, and others showed the relation between tonsils and chronic oral infections of the teeth and jaws and diseases in other parts of the body. With few exceptions their statements have been accepted in full, or in modified form, but some members of the medical and dental professions have gone far beyond the claims of either Dr. Billings or Dr. Hunter, and attribute almost every conceivable bodily ill to the teeth and tonsils, when the symptoms do not definitely point elsewhere.

The two infections of the mouth which are instrumental in causing secondary disease are chronic alveolar abscess and pyorrhea alveolaris, the latter a disease only in the adult. Their prevalence is indicated by a study made by Dr. Arthur D. Black, of six thousand radiographs of six hundred adults' jaws, taken without reference to the condition of the teeth or health. He found 78 per cent had either chronic alveolar abscesses or pyorrhea, 55 per cent having alveolar abscesses and 53 per cent pyorrhea.[3]

There are two kinds of chronic alveolar abscesses, the encapsulated or walled off variety and another kind which has no capsule. The latter is filled with infected granulation tissue, having direct communication thru the lymphatics and blood vessels with the adjacent healthy bone. The dissemination of dangerous germs is more likely to occur from the nonencapsulated variety. Chronic alveolar abscesses occasionally have sinuses opening on the gums, on the face and into the maxillary sinus. A large percentage of antral infections are due to abscessed teeth.

Primarily pyorrhea is a disease of the peridental membrane and, with the exception of dental decay, is the most common mouth lesion. While the greater part of the pus and bacteria from pyorrheal pockets is discharged into the mouth, there is reason to believe that some of the bacteria may enter the blood and lymph channels directly from the pus pockets. Dr. Hatton of the Research Department at Northwestern University Dental School was able to demonstrate bacteria in the walls of pyorrheal pockets, and in the peridental membrane, usually perivascular in position.[4] In addition to the open infected areas, foci of infection are found in the peridental membrane far beyond the bottom of pyorrheal pockets, the bacteria having reached these isolated positions thru the lymph channels in the peridental

[3] *Jour. Amer. Med. Assoc.*, LXXI (1918), 1279.

[4] *Ibid.*, p. 1549.

membrane. Such infections at times develop acute exacerbations which later become chronic and remain definitely closed infected processes.

If all of the teeth in the jaws had apical abscesses, the combined infected areas would be much less than if all of the teeth were involved in pyorrhea. In addition to the dissemination of bacteria from pyorrheal pockets thru the lymphatics and blood vessels during the progress of the disease, there is discharged into the mouth much bacteria-laden pus, which is swallowed. There is difference of opinion as to whether the pus and bacteria from this source cause gastro-intestinal disturbance, but reports of cures of such diseases following the elimination of extensive pyorrheal pockets may justify the assumption that pyorrhea does contribute to gastro-intestinal disease. Oral sepsis, according to Dr. Hunter, is a potent and persistent cause of septic gastritis.[5] Dr. Hunter also believes that what he terms "septic anemia" is due to oral infection, and Dr. Osler makes similar statements.[6] Since pyorrhea offers a greater area of infection than chronic alveolar abscess, and since it may at times be a closed process, it may be a greater menace to health, and therefore it should receive due consideration in seeking the cause of disease, the etiology of which is obscure.

When we revert to the researches of Drs. Vaughan, Koessler, Walker and others, concerning the toxicity of various proteins and their split products and their relation to hypertension and other disturbances, the importance of infections about the teeth is still further emphasized. The fact that deep pyorrheal pockets afford easy entrance for the products of infection into the blood is not to be overlooked, and a survey of the mouth for possible lesions should be included in the medical management of all such cases.

[5] *Pernicious Anaemia*, p. 233.

[6] Osler and McCrae, *Modern Medicine*.

Evidence at hand showing the relation between chronic oral infection and secondary disease is too positive for refutation and cannot be too strongly emphasized, but the indiscriminate removal of teeth and tonsils, without positive evidence of their being the cause of secondary disease, is unwarranted and unfair to patients. Thru newspaper propaganda and the claims of over-enthusiastic physicians and dentists, many people have been thrown into a state of panic, and thinking their health jeopardized by their teeth and tonsils are requesting their removal, independent of medical advice.

Some dentists and some physicians, who have not properly considered the subject, seem to have lost all sense of perspective, as a result of having too closely focused their attention on the teeth and tonsils in seeking the cause of disease, to the exclusion of other parts of the body having equal or greater infected areas; also, by attributing certain illnesses to chronic infections which are not dependent on them. It is as unscientific to attribute all cases of neuritis and arthritis to pulpless teeth, regardless of whether they are infected or not, as to attribute all bronchial asthma to polypoid growths in the ethmoid cells. Moreover, errors are occasionally made in attributing certain diseases to abscessed teeth in cases in which a carefully taken history would have disclosed the fact that the onset of the disease antedated the death of the pulps of the teeth.

Some dentists have been led to believe that the white cell blood count, especially, varies in arithmetical progression with the number of pyorrheal pockets of a certain depth, also with the number and extent of chronic alveolar abscesses as indicated by radiographs. In my clinic, Dr. Hatton has been able to demonstrate the evident absurdity of such notions by the examination of several hundred patients having alveolar abscesses, pyorrheal pockets, and other mouth diseases. Leucocyte counts furnish information of

value only in exceptional cases of mouth conditions, and the leucocyte reaction is not in any essential different from that due to infection elsewhere in the body.

Indiscriminate removal of tonsils is reprehensible, but their loss, so far as known, is inconsequential as compared with the loss of teeth.

It would be unfair to impugn the motives of some dentists who daily remove many teeth, or some rhinologists who remove many pairs of tonsils, but one naturally wonders if there is not danger of the practice becoming commercialized.

There are two terms commonly used by some physicians and some dentists, which should be eliminated, since they give erroneous impressions. These are "dead teeth" and "nonvital teeth." Usually dead or nonvital teeth are abhorrent to adjacent live tissues, and when present, eliminating forces are at once set up for their removal. What really is meant by those who improperly use these terms is not that the teeth are wholly devoid of life, but that they are pulpless.

The pulp of a tooth is the formative organ of the dentin and is transitory. If one lives to very old age it disappears; the tooth still lives since the cementum of the root receives its nutrition wholly from the peridental membrane. The death of the pulp affords opportunity for apical infection, but if the root-canal of a pulpless tooth is made aseptic and is hermetically sealed, the root does not usually become infected and alveolar abscess does not follow. This refutes the statement that "all pulpless teeth are a menace to health." If the peridental membrane of a tooth is completely destroyed, the tooth becomes necrosed, and then and only then does it become a "nonvital" or "dead" tooth.

If only a limited part of the cementum about the apex of the root has been denuded of its peridental membrane, as the result of an alveolar abscess, the condition may generally be cured by disinfecting and filling the root-canal, and in other cases, even tho a considerable part of the cementum is denuded, it may be cured by resecting the dead cementum and draining the infected area. Prior to this operation, the root-canal must be disinfected and filled. Because of anatomic reasons, resection of root is usually restricted to the eight anterior teeth. As remarkable cures of secondary diseases dependent on abscessed teeth have been brought about by root resection and thoro drainage as have been made by the extraction of similarly infected teeth.

There is much unwarranted, spectacular operative procedure called "surgery," which removes all adjacent osseous tissue in connection with removal of abscessed and pyorrheal affected teeth. In some cases where there has been extensive bone destruction, operative procedures may be indicated, but ordinarily the removal of the tooth suffices. The examination of two thousand radiographs of edentulous or partially edentulous jaws, taken for me in my clinic and private practice, in which no curettement or surgical procedures had been observed, revealed only three alveolar abscesses which had persisted after the teeth had been removed. The removal of granuloma, especially if extensive, may hasten recovery and in some instances is indicated, but too much surgery has led to diffusion of bacteria thru adjacent tissues with serious results.

I might incidentally refer to the use of radiographs in connection with abscesses of the jaw. The radiograph offers means of determining the extent and location of chronic alveolar abscesses. However, it must not be forgotten that radiographs are only shadow pictures and are often deceptive. The angle of exposure materially changes the shadow, giving different representations of the same thing. If one depends wholly on radiographs to determine such conditions, he may be led to wrong conclusions. For instance, occasionally, a radiograph indicates deep pyorrheal pockets which,

when the mouth is examined are not found. The gums as well as the alveolar process have become atrophied at the same time, and as a result much of the necks of the teeth are exposed, giving the appearance in the radiograph of pyorrhea, which does not exist. Occasionally the shadow of the maxillary sinus is mistaken for a cyst or abscess; the mental foramen may also be mistaken for an abscess. A knowledge of the anatomy and histology of the oral tissues, coupled with experienced observation, is necessary for the proper interpretation of radiographs of teeth.

Sir James Mackenzie[7] has well said: "Disease is rarely recognized until it has impaired the health of the individual and produced suffering; and the concentration of attention to this stage has diverted the attention from the preceding stages," and we may add, has diverted attention from the cause that led up to the preceding stages.

We must start with the child at birth and care for him until he reaches manhood, if we would save him from many of the ills of life, since it is at a comparatively early period that causes for oral sepsis begin.

When a child is born the enamel of the temporary incisors and cuspids is nearly complete, and that of the deciduous molars is a little less than half finished, and is fully completed seven months after birth. Owing to this early development of the protective portion of the deciduous teeth, their structure is not influenced by diseases of childhood, and therefore are usually perfect in formation and rarely irregularly placed in the jaws. With the exception of the first molars, the deposition of lime salts forming the second set of teeth does not commence until about twelve months after birth. The first molar has usually begun at birth. About this time the incisal edge of the central incisors and the cusps of the occlusal surfaces of the first molars are laid down. The enamel of the incisors and first molars is completed between the fifth and sixth years, that of the cuspids, bicuspids and second molars between the eighth and ninth years, and the third molars about the twelfth year. It is during the period of enamel formation of the second set that disease and malnutrition injuriously affect the shape and quality of these teeth, causing defects in the enamel, which definitely correspond to the stage of development of the teeth at that period. The health of the first three years of life, so often modified by illness arising from faulty nutrition, contagious disease and other infections, frequently determines that the child whose heredity would entitle him to a perfect mouth, may have to go thru life a sufferer from dental caries or deformed unsightly teeth.

Observation leads me to believe that scarlet fever, measles and other eruptive febrile diseases of childhood produce more profound defects in the teeth than do other even more depressing diseases, such as rickets or congenital syphilis. The inclusion of notched and narrowed teeth in Hutchinson's triad with interstitial keratitis and labyrinthine disease, a syndrome commonly and properly attributed to congenital syphilis, is somewhat unfortunate, since not all teeth so deformed are due to syphilis, and therefore the stigma is, in certain cases, unjustly placed on parents. If notched and narrowed central incisor teeth of the second set were always due to hereditary syphilis, it would seem that the deciduous set would likewise have shown such defects in those definitely syphilitic at birth. But as a matter of fact they do not, while their counterparts in the second set developed after birth are often defective, especially if the child has had depressing diseases or suffered from malnutrition. It would seem possible, therefore, that defective teeth seen in syphilitic children may arise from the malnutrition associated with syphilis, but

[7] *The Future of Medicine.*

not necessarily more from syphilis than from other diseases of like duration and extent.

If teeth are grooved, pitted, or otherwise malformed when erupted, these defects afford opportunity for lodgment of food debris, and for acid-forming fungi, which produce the lactic acid that attacks the enamel and later the dentin, causing decay. Unless that part of a tooth destroyed is restored by artificial means before the pulp is exposed, the pulp dies, with alveolar abscess as an almost certain sequence.

Children rarely have dental decay until they are approaching their second birthday. This seems to indicate that the change from infant diet to a mixed diet is a factor in the production of decay in children's teeth. The studies of Drs. D. J. Davis, Jackson, Moore, and others have definitely proved that improper diet has a positive injurious influence on the gums and underlying bony structure. Scurvy, which is supposed to be due to dietetic causes, profoundly affects the same tissues. With these facts in mind, we may suppose that improper feeding changes as well the secretions of the mouth, so that certain constituents which normally inhibit the growth of acid-forming fungi are lacking, or that others are supplied, which in combination with food remaining about the teeth, give the best possible medium for bacterial growth. If this is true, we may believe that since dental decay begins with the change of diet, that error in property balancing the diet may have much to do with decay of teeth. May we not raise the question as to the probability of improper diet being fundamental as a predisposing cause in other infections about the mouth, such as pyorrhea alveolaris, a disease the etiology of which is obscure?

Doubtless there are many other factors which cause or counteract dental decay and some of the other diseases of the mouth. Heredity probably plays an important part. There are many marked characteristics in the child's mouth which are without doubt due to heredity. The resemblance in quality and shape of the teeth and jaws of children and parents is noticeable in some families. The tendency to decay is likewise noticeable. Cleft palate, hare lip, and cancer, on the other hand, I have been unable to associate with heredity.

Of the child's first teeth, the molars are most subject to decay. If these teeth are neglected and decay, their pulps become exposed and the child suffers pain from mastication, and as a result he bolts his food, thereby throwing an unnecessary amount of work on the stomach. Later the pulps die with alveolar infection as a certain sequence, and as a result a definite channel is opened from the infected roots to the blood stream thru which pass bacteria from the mouth. Any organism which may have found temporary abode in cavities of dental decay, such as tubercle bacilli, actinomyces, and possibly other infections, may pass thru these channels. Reports by Dr. Fones of the Bridgeport schools[8] and Dr. Guthrie of the New Orleans schools show definite lessening of contagious diseases among children as a result of perfect oral hygiene.[9] One cannot but surmise, however, that the improved conditions in personal hygiene, other than that of the mouth which necessarily must accompany and result from the degree of co-operation of parents and children in attending so great dental improvement, must have been an important factor in obtaining this striking decrease in contagious disease. Dental decay, especially if situated between teeth, forms pockets into which food wedges and decomposes, with resulting pain, infected gums, and peridental membrane. As the bacteria from these infected areas, in their excursion from the mouth to the stomach, pass the stomach, pass the tonsils, some may find

[8]Bridgeport School Report.

[9]*Jour. Amer. Med. Assoc.*, LXXV (1920), 1245.

lodgment there and cause disease of these organs. Others pass thru the lymph channels to the submaxillary lymphatics, causing lymphadenitis. These facts apply to the teeth of adults as well as to those of children. Dr. Sweitzer, in 1909, succeeded in injecting the lymphatics of the dental pulp. In 1914, Drs. Noyes and Dewey of Chicago repeated the work of Dr. Sweitzer and, in addition, succeeded in injecting the lymphatic capillaries of the submaxillary glands of the neck thru the pulps of the teeth, demonstrating the continuity of lymph channels between the tooth's pulp and the submaxillary glands, thru which may pass bacteria from the mouth.[10] Dr. Odenthal reports finding submaxillary glandular swellings in 99 per cent of all children having badly diseased teeth and only 49 per cent in those having sound teeth.[11] Dr. Gilberti showed the prevalence of tubercle bacilli in the mouth by injecting into guinea-pigs, previously subjected to the tuberculin test, emulsion of inguinal and also of cervical glands, taken from children believed to be dead of non-tuberculous disease. Of 30 animals injected with cervical gland emulsion, 11 died from tuberculosis. Of those injected with material from inguinal glands, only 2 died of tuberculosis.[12]

Examination of the mouths of the children of the grammar schools in the poorer districts in Chicago showed that 98 per cent had diseased teeth. In some the teeth were so badly decayed that their masticating surfaces were destroyed beyond repair, and in addition there were numerous abscesses. In some, the gums were so badly infected as a result of dental neglect that pus was being discharged from one end of the dental arch to the other. Dental caries and attendant infection of the gums, together with acute and chronic alveolar abscesses, no doubt contribute to a large extent to the malnutrition, nervous disorder and delinquency among the poor children of the city. The great question before us is: What can be done to prevent such conditions? Much has been done in the Forsyth Dental Infirmary in Boston, the Eastman Dispensary in Rochester, New York, and by the school authorities in Bridgeport, Connecticut, and in other cities.

We have only 2,500 dentists in this city and 310,481 children in our grammar schools alone. If the dentists of this city should serve the school children who never receive dental attention, they would have little time left for their private practice. The situation may be relieved by a system which has proved successful in other municipalities. This system provides for the instruction of women in the care of children's teeth. They are a part of the school faculty and are on duty thruout the school year. They are known as "dental hygienists" in some cities and "dental nurses" in others. Their duties are to thoroly clean the teeth of the school children several times a year, to examine their teeth for dental decay, and the mouth for other diseases, and to tabulate conditions found. If the child is in need of dental service, he is referred to the family dentist, if one is employed; if not, he is referred to the dental infirmary. The dental hygienists also give instruction in the care of the mouth and teeth by toothbrush drills. They inspect each child's mouth at frequent intervals to find whether he has given it proper home care. School instruction in the care of teeth does not reach the child as early in life as it should to secure the best results, but instruction of the grammar school children in the care of their teeth will tend to educate both the parents and younger children of the family in the importance of better habits of oral cleanliness. An effort is being made by the

[10] *Dental Cosmos*, LXII (1920), 1037.
[11] *Therapie des Maladies Infectieuses*, p. 256.
[12] *Medical Practice Series*, III (1910), 313.

Social Service Bureau of Chicago to introduce oral hygiene into the day nurseries.

This work can be carried on in the most complete manner only under school board and municipal authority. The employment of dental hygienists in sufficient numbers to care properly for the pupils in all of Chicago's grammar and parochial schools would call for a heavy financial outlay, but when the gain in mental and physical condition is considered, it would seem that the state can well afford it. By putting this system into practice, the teaching force may be materially decreased, because it has been found that children who have been generally delinquent on account of diseased mouth conditions make their grades easily, and in some instances make double promotions, after their mouths have been restored to health. The education of women to act as dental hygienists can most economically and conveniently be accomplished in the already existing dental schools, since these schools have the facilities, including teaching force and clinical material necessary for their instruction.

During the past twelve months several papers have appeared in prominent medical journals, relating to delinquency and nervous disorders in children, but in none of these was mention made of oral infection as a possible cause, tho dietetics, heredity, and environment were cited as etiologic factors.

We hear much of preventive medicine, but preventive dentistry must be intimately associated with preventive medicine if we would eliminate some of the more common causes of disease. Preventive medicine has not generally included hygiene of the mouth in its work and so has missed one of the most promising avenues of attack on fundamental causes of disease. Many corporations, however, have grasped the idea that unclean, unhealthy mouths are detrimental to health. The Metropolitan Life Insurance Company in its *Daily Bulletin* of April 29, 1919, says: "The services rendered by the dental division since its establishment in 1915 have been so curative of impaired health conditions and so permanently helpful to the employees who have taken advantage of the opportunities offered, that henceforth every home office will require its employees to undergo examination and cleansing of the teeth, in the home office, dental division, twice a year."

All boards of health should have one member who is a high-grade dentist to superintend a corps of dentists and dental hygienists who care for the mouths of children in the grammar schools. Owing to the extension of time now demanded for the education of dentists and the requirements of one year of college as a requisite for entrance to dental schools, there will not be as many dentists in the United States two years hence as there were a year ago, since death and voluntary retirement from practice will more than offset the number graduating in this time. There are only 48,000 dentists in the whole country, a number wholly inadequate to dental needs, if all the people recognized the importance of oral health.

We have been slow to recognize the importance of clean healthy mouths and consequently dentists have not been able to exert an influence as beneficial as they might otherwise have exerted. When we are all brought to realize fully that unhealthy mouths are a prolific cause of ill health then, and only then, will a systematic effort be made which will bring about correction of present neglect. Dentists must play an ever-increasing rôle thru the care of the mouth in the prevention of disease.

DIET IN RELATION TO ORAL HYGIENE[1]

By WALLACE SECCOMBE, D.D.S., Toronto, Canada

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

Diet in Relation to Oral Hygiene

Dental disease—Most prevalent disease afflicting civilized man—the more civilized the race, the more dental disease.

Preventive dentistry—A boon to humanity—one ounce of prevention better than a pound (16 ounces) of cure—advantage sixteen times greater.

Six Reasons for Prevention of Dental Disease

1. Lost tooth tissue not restored.
2. Substitute materials are inferior.
3. Pain and expense are involved.
4. Serious systemic lesions result.
5. Infected areas often inaccessible.
6. Cure frequently impossible, resulting in entire loss of tooth.

Loss of Teeth a Serious Menace

1. Masticatory efficiency impaired.
2. Elongation of opposing tooth.
3. Tipping of teeth, either side of space, and bodily drifting.
4. Resorption of surrounding tissues.
5. Prosthetic restorations inferior to nature, from standpoint of utility and esthetics.

Save the Teeth

The uncertainties and difficulties of dealing with dental focal infection seem to constantly increase. Apical infection is a sequela of dental disease. Therefore dentistry's real problem is prevention.

Practitioners who render modern dental service concern themselves with the cause as well as the cure of dental disease. They are both dental physician and dental surgeon.

The Problem of Immunity and Susceptibility

to dental disease is most complex. Many factors (about which we know comparatively little) are concerned, and these usually operate in conjunction. The process of fermentation, simple enough in laboratory, becomes involved with many other influences when carried on in the oral cavity.

Immunity—Normal healthy individuals, living physiologically and possessing dental organs perfect in quality, form and arrangement, are immune to dental disease.

Susceptibility—Every deviation from normal, in either anatomic form or habits of living, predisposes to susceptibility.

Nature's immunizing forces frequently overcome disintegrating factors—in majority of cases, however, under modern methods of living, dental disease occurs.

Factors Influencing Susceptibility and Immunity

may be divided into two classes:

1. Anatomical—The inherent qualities of the tooth and its relation to other teeth.
2. Environmental — Influences surrounding the tooth and operating from without.

All factors involved, however, tho discussed as separate questions, are in-

[1]Manuscript presented in form of a series of slides, author making explanatory remarks while slide was on the screen.

timately related. Each in some way affects the other.

For instance:

Anatomy / Food	affect	mastication.
Mastication—	affects	anatomy. / digestion. / saliva. / oral cleanliness.
Food—	affects	digestion.
Digestion—	affects	saliva.
Saliva—	affects	oral cleanliness.

Thus we may and do have many vicious circles established, making the primary cause of dental disease difficult to identify.

Dental Diseases

Periclasia (path of infection, tissues surrounding tooth)—Howe has shown relation of systemic conditions to periclasia—tissue alteration primary cause, bacterial invasion secondary—infection preceded by chemical or mechanical tissue disturbance.

Caries (path of infection, pulp and root-canal)—Dissolution of tooth resulting from acid, by-product of carbohydrate fermentation, retained in contact with tooth. Acid is retained and protected from dilution in the saliva by reason of mucinous film or anatomic fault.

The Mouth—ideal incubator—bacteria always present to cause fermentation or putrefaction when suitable pabulum offers.

In both periclasia and caries important factors involve questions of mastication, diet and digestion.

Dental Disease and Digestion

The oral cavity—an integral part of the digestive tract—cannot be considered as something apart.

The teeth constantly bathed in saliva, one of the digestive juices, the character and composition of which are constantly influenced by dietetic and digestive considerations.

The increased incidence of dental disease and diseases of the digestive tract has occurred simultaneously, and is doubtless of common origin.

The digestive tract has been compared to an extensive chemical factory, composed of a series of passages and compartments, in each of which the food (according to its properties) is retained for a time or sent on at once to the next. Each compartment is provided with suitable reagents. The food is finally brought into a condition in which it is capable of being absorbed into the body fluids and built up into the tissues.

The Alimentary Canal

is about thirty feet long, of which only three inches (the mouth) are under the control of the will. With the exercise of proper control (both food and mastication) over the voluntary three inches, little concern need be given to the involuntary thirty feet.

The Oral Cavity

Intelligent control of this portal of entry will bring about the operation of nature's forces of resistance. This will not only predispose to mouth health, but to the elimination of most of the diseases of the digestive tract, including stomach, liver, kidneys, and intestinal disturbances.

Food

Foods are divided into four groups:

1.	Carbohydrate.....	Energy producing.
2.	Fats	
3.	Protein	Tissue forming, Repair waste.
4.	Inorganic	Bone forming Neutralize acidity

Fermentation—The carbohydrates (carbon with hydrogen and oxygen in same proportion as in water) break down by fermentation with formation of acid by-product. Associated in mouth with caries.

Putrefaction—The proteins (nitrogenous) break down by putrefaction with alkaline end-product and putrid odor. Associated in mouth with periclasia.

A diet may be right in quantity, but contain too little of one food and too much of another, i. e. "out of balance."

A balanced diet is one containing sufficient of each of these elements.

Amount of each element required to

give balance varies according to age, temperament, mode of living, energy expended, climate, etc.

For instance,

Two children in same family partaking same diet, one susceptible to caries, the other immune. Amount of energy expended makes diet right for one and wrong for other.

There may occur over-ingestion of a balanced diet, or, more unfortunate still, over-ingestion of an unbalanced diet.

Harold Clark has shown that over-ingestion is more frequent where sugar, jams and sweetened deserts are taken freely.

Kirk claims that over-ingestion of carbohydrate makes it impossible for blood, muscle, liver, to store sufficient of this element in metabolic form, with resultant overflow and presence of metabolic carbohydrate in saliva.

Carbohydrates are necessary to supply body energy, but if over-ingested satisfy hunger without supplying other essential food elements.

Foods Classified

Most foods contain some of each of the four elements. Foods are classified, however, according to element that predominates.

CARBOHYDRATES	PROTEINS (Animal)
Vegetables (except vegetable protein) Grains (cereals, rice, flour) Fruits	Meat Eggs Fish Cheese Fowl
Sugar (very concentrated) Confections, Syrups, Honey, Jams, Marmalades, Cakes, etc.	(Vegetable) Peas Lentils Beans Nuts
INORGANIC	FATS
Vegetables Fruits Greens Bran (in whole wheat)	Meat Fat Cream Nuts Butter Vegetable Fats

Milk contains elements of each class.

Take some food indicated in each group at each meal. Use sugar or its combinations in great moderation. Use cereals and bread moderately. Use fruits, vegetables, greens, etc., liberally.

Even a sandwich may be so prepared as to contain one food of each class:

Carbohydrates	Fat	Protein	Inorganic
Bread	Butter	Egg or Meat or Nuts or Cheese	Lettuce

Authorities are agreed that in modern life there is a serious over-ingestion of carbohydrate foods, and particularly of sugar.

Sugar Consumption

In United States Sugar Consumption Has Increased 500% in 50 Years

In the year			1865,	18 lbs.	consumed	per capita
"	"	"	1875,	45 "	"	" "
"	"	"	1885,	54 "	"	" "
"	"	"	1895,	62 "	"	" "
"	"	"	1905,	75 "	"	" "
"	"	"	1918,	77 "	"	" "
"	"	"	1919,	93 "	"	" "

Dominion of Canada Sugar Consumption

In the year 1919, 95 lbs. consumed per capita

Countries with lower sugar consumption suffer less from dental disease. Government statistics indicate that over-ingestion of sugar is most marked in English-speaking countries where dental disease is most prevalent.

Ninety pounds of sugar is an average of four ounces per day. A man working hard in the open air can barely consume (oxidize) that amount.

The sugar is a concentrated food, and used in excess, irritates the digestive organs.

In refining sugar the mineral elements so valuable to the human body are entirely removed. For instance, sugar refined and as found in beets.

Inorganic Element

Quality of tooth not permanently fixed—teeth osmotic—resistance to disease affected by both systemic and local conditions.

Bunting has shown greater susceptibility where calcium content of saliva comparatively low.

Inorganic constituents of body may be increased by diet high in these elements,

such as fresh vegetables, skimmed milk, and buttermilk.

High calcium content of saliva tends toward maintenance of hard surface of teeth.

Special necessity for diet high in inorganic content, during developmental period—diet of mother during pregnancy particularly important.

CASE REPORTED BY DEPARTMENT OF PREVENTIVE DENTISTRY, ROYAL COLLEGE OF DENTAL SURGEONS

Child 12 months, breast fed, teeth normal at eruption almost denuded of enamel, marked gingivitis, vomit after every feeding daily since birth.

Analysis of mother's milk showed high sugar content and low in protein.

Mother's diet confined entirely to bread, cakes and jam with from 12 to 15 spoonfuls of sugar a day in tea and coffee. Very little protein and no mastication. Similar history for four previous children.

Normal mothers' milk is certainly best. Bottle feeding preferable, however, in case such as above, providing food scientifically prepared and jaws exercised in feeding.

ANALYSIS OF MOTHER'S MILK

	Analysis	Normal (Blythe)
Sp. Gravity	1.0308	
Water	87.9	88.
Total solids	12.1	12.
Fat	3.35	2.9
Proteins	1.13	3.
Sugar (lactose)	7.36	5.87
Ash	.26	.16

Unbalanced diet for child, result, dental disease.

DISADVANTAGES OF OVER-INGESTION OF CARBOHYDRATE FOODS

including the cereals (seed products), bread, cakes and flour products.

Because—

1. When mixed with saliva they become particularly sticky and particles have a tendency to cling to the teeth (alimentary carbohydrate).

2. Over-ingestion may lead to insidious return to the mouth of carbohydrate elements—(metabolic carbohydrate).

3. Modern milling methods eliminate vitamines and important inorganic elements.

ADVANTAGES OF FRUITS, VEGETABLES AND FOODS HIGH IN INORGANIC ELEMENT.

First—Local cleansing action of fruit acids and fibrous vegetables.

Second—Aid digestion and peristalsis.

Third—Have basic end-product, maintain calcification of osseous tissues.

Fourth—Saliva higher in calcium content, alkalinity increased.

Fifth—Predisposes to maintenance of hard surfaces of teeth.

Sixth—Contain vitamines.

ACCESSORY FOOD FACTORS

(Vitamines)

Diets composed of chemically pure proteins, carbohydrates, fats, and inorganic elements, result in disease and death of experimental animals.

In other words, synthetic milk does not contain certain vital factors essential to health and growth, whose presence may be determined only by biological methods. Analysis may show natural milk and synthetic milk precisely the same from the standpoint of chemical composition, but there is a vital difference.

These essential biological factors are known as "accessory food factors" and are popularly called "vitamines."

In modern foods these vital factors are removed or destroyed during the process of manufacture, notably in the case of white flour, and gelatine deserts. Thus, a meal composed of white bread, cake, sugar, manufactured desserts, tea, coffee, is entirely lacking in these essential elements.

USE ALL PARTS OF PLANT

McCollum has shown that "whole grain" is not sufficient, but it is necessary to include all parts of the plant in a balanced diet, namely,

Leaf, seed (tubers), root. Each contains elements lacking in the other, and

supplies necessary "bulk of food" less concentrated.

Vitamines are contained in: meat, milk, eggs, fresh vegetables, whole wheat.

Milk and leaves of plants should never be omitted from the diet. The latter include spinach, celery, lettuce, cabbage, chard.

Mucus

Body lubricant—Assists in formation of bolus of food and deglutition.

Body protective—When irritant or noxious material swallowed, increased flow of mucus occurs. Pavlov reports 100 times the normal amount of mucus secreted by mucous membrane when surface of stomach irritated by potent reagent. Thus tissue cells are protected and noxious substances are diluted or new combinations formed.

Indigestion (over-ingestion, bolting of food, over-ingestion of sugar, lack of dietetic balance), causes irritation and increased flow of mucus. The mouth is hyper-mucinated, resulting in increased susceptibility to plaque formation.

Normal Saliva

Free passage of saliva over teeth cleanses surfaces and prevents dental disease.

When saliva ceases to flow freely, in actual contact with the surfaces of teeth, fermentation occurs providing carbohydrate pabulum be present.

Free flow of saliva prevented by: (a) Capillary attraction operating in suitable spaces. Capillary spaces may even occur about contact points where lateral movement has worn contact flat. (Colyer.) (b) Mucinous plaque. Saliva passes over debris without touching surface of tooth.

Importance of irrigation in modern surgery—salivary circulation (irrigation) a vital factor in immunity to dental disease.

Anatomical Factor

Many teeth susceptible because of deviation from normal form or arrangement, or defect in enamel surface.

When teeth are anatomic, salivary flow passes over all surfaces, with beneficent result. Anatomical defects prevent free salivary flow over surfaces of the teeth just as effectively as mucinous film. Carbohydrate pabulum, dissolved in saliva (and either of metabolic or alimentary origin), is held in contact with tooth surface by capillary pressure between surfaces of teeth and in deep fissures or pits where the force of capillary pressure operates.

Lodgment of food debris is due to faulty contact, lack of marginal ridges of malocclusion. Roughened surfaces, overhanging margins, may be cause. How frequently are fillings left in the mouth, with faulty contact and absence of anatomical form, simply because they cannot be dislodged with an explorer? Anatomical restorations vitally important.

Mastication

Household science teachers, in preparation of table food, sometimes overlook the need of the teeth for adequate exercise.

The food should be of such a form as to require thoro mastication without injury to the teeth—fibrous rather than hard. Thoroly insalivate all food, particularly starches, as the action of salivary ferment (ptyalin) is first step in the conversion of starches to sugar.

Thoro mastication imperative:

(a) Development of parts.

(b) Exercise of jaws—proper blood supply to tooth and surrounding tissue. Increased resistance to infection.

(c) First step in digestion.

(d) Excites abundant flow of saliva.

(e) Cleansing of surfaces of teeth. Cleansing action of mastication clearly shown in cases of unilateral mastication.

(f) Thoro mastication is check on over-ingestion.

F. C. Husband recommends as guide to patient,—chew pultaceous foods 20 times; bread 50 times; meat, corn, etc., 100 times. This constituted mouth efficiency.

Oral Hygiene

Germicides—

—Interference with activity of tissues.

—Drug unknown that destroys microorganism without injury to tissue cell.

—Presence of germs in mouth normal. Nature builds up immunizing factors in healthy tissue cell.

Prophylaxis—

Hopeless for dental operators and periodontists to confine treatment to removal of local product of disease, and give no concern to initial cause.

Artificial cleansers—

Toilet necessity.

More important as a toilet necessity than as prophylactic measure.

Summary of Nature's Forces Predisposing to Dental Health

1. Anatomical—perfect masticatory apparatus—quality of tooth—form—and arrangement.
2. Correct diet — (quantity — balance—mastication).
3. Good health and general immunity.
4. Normal saliva, nature's mouth wash.
5. Efficient mastication, nature's dentifrice.
6. Movement of lips, cheeks and tongue upon mucous membrane and exposed surfaces of the teeth.

Correct Habits of Living

Some immune individuals do not use a toothbrush.

Some susceptible people suffer caries in spite of constant artificial cleansing by most approved methods.

Correct habits of living bring immunity.

Reparative process is necessary, but that is only first step toward real treatment, which is preventive dentistry.

Conclusions

First—Oral bacteria not determining factor in dental disease—present in both susceptible and immune cases—normal.

Second—Presence of carbohydrate an essential element in caries.

Third—Salivary stasis always present in dental caries.

Fourth — Fermentation occurs in mouth when flow of saliva over free surface of tooth is interfered with:

(a) Anatomical consideration, capillary pressure.

(b Mucinous debris.

Fifth—Anatomical consideration vital—make all operative and prosthetic dental restorations true to anatomic form.

Sixth—Indigestion, associated with increase of mucus, predisposing to accumulation of debris.

Seventh—Excess of those foods which result in acid end-product in tissues, depreciates inherent quality of tooth, thus favoring susceptibility.

Eighth—Dentists must practice as dental physicians, as well as dental surgeons.

Suggestions for Clinical Observation

Caries without salivary calculus	Over-ingestion of sugar
Caries with salivary calculus	Over-ingestion of bread and flour products
Salivary calculus	Over-ingestion of any food
Gingivitis	Over-ingestion auto-intoxication, trauma
Thickened saliva hpyermucinated	Indigestion—Character of diet or lack of mastication

Acknowledgment

In preparing manuscript in a subject such as this, it is impossible to mention all the authors to whom one is indebted, but I desire to express appreciation to the following: Pavlov, Pickerill, Sim Wallace, Kirk, Black, Howe, Sherman, Talbot, Bunting, Johnson, Head, Addis, Gies, Colyer, and McCollum.

REPORT OF STUDIES AND THE TECHNIC FOR GOLD INLAYS

By ROBERT E. BLACKWELL, D.D.S., Chicago, Illinois

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

FOR convenience of description, gold-inlay technic may be divided into the following parts: (1) the preparation of the cavity to receive the filling, (2) the manipulation of the wax in securing the pattern, (3) the investment of the pattern and its dissipation from the mold, (4) casting, (5) contour and finish.

The relative importance of these several steps cannot be computed upon a percentage basis; but it seems perfectly safe to say that one's failures would mount to 100 per cent unless his cavities had been properly prepared. Given a perfect cavity, it is possible to make a good inlay by any one of several methods; but no method or technic, however perfected, can compensate for an imperfection in any part of the foundation of our structure, that is the cavity.

The late Dr. G. V. Black gave to the profession a system of cavity preparation, a mastery of which, in the opinion of the writer, is essential to the highest attainments in operative dentistry. Dr. R. H. Volland[1] recently emphasized this fact when he stated that we have been given a system founded upon demonstrable scientific facts, which requires only slight modifications in minor details to be adapted to the use of gold inlays. No dentist can render his best service until he has mastered the principles upon which this system is based.

[1]R. H. Volland, "Gold Inlays," *Jour. Nat. Dental Assoc.*, VII (1920), 480.

Gold inlays seem to find their greatest usefulness in the bicuspid and molar teeth, particularly on the proximo-occlusal and mesio-occluso-distal cavities. Therefore this paper will be confined to the treatment of these cavities and to the construction of inlays for them. Time will not permit of a complete discussion of the principles governing the outline form of a proximo-occlusal cavity. This would involve the important subject of extension for prevention, which is too large to be taken up in detail in this paper. Altho it does not seem advisable to describe the instrumentation and technic for cavity form step by step, it does seem desirable and justifiable to emphasize at this time some points which are not being given the attention they deserve.

In a normal occlusion, the occlusal surfaces of the teeth are clean surfaces, because of the friction of mastication over them. The inclined planes of the cusps and ridges are scoured and polished during mastication so that there is no opportunity for the micro-organisms to lie in contact with tooth structure long enough for caries to occur, unless the organisms lodge in structural defects in the enamel pits or fissures. But proximal surfaces, while free from structural defects in the enamel, are not scoured by the friction of mastication over their entire area. The region gingivally of the contact point is so perfectly protected from the excursions of food that colonies

of micro-organisms may attach themselves to the enamel and work practically undisturbed. The unclean area thus protected is called the area of liability. This area may extend buccally, lingually, and gingivally, according to the conditions. Buccally and lingually, any extension of this area will be limited by the excursions of food thru the embrasures. The contour of the proximating teeth determines the width of the embrasures; the position of the opposing cusps controls, to a large extent, the excursions of food thru the embrasures. As superficial caries does not occur under healthy gum tissue, the position of the septal tissue determines, in many instances, the extension of the area of liability gingivally. It will be readily seen, then, that the factors which control the location, shape and extent of the area of liability are very variable and must be studied carefully when each case presents, for, *if future caries on the surface involved is to be prevented, the entire area of liability must be included in the cavity outline and the cavity margins must be laid in areas of immunity.* This usually means that the buccal and lingual margins of the proximal portion should be placed near the axial angles.[2] There is no difference between the outline requirements for gold inlays and those for gold foil or amalgam fillings. In all cases, the buccal and lingual margins of the filling should be placed where they will receive the frictional action of excursions of food during mastication. These will be self-cleansing margins which will not be the seat of future decay.

In preparing a cavity which has originated on the proximal surface it is almost always necessary to involve a portion of the occlusal surface, that is, the marginal ridge. When this has been done it immediately becomes necessary to include more of this surface for stability and retention and, in many instances, to insure a smooth margin against which to finish the inlay (Figs. 1-3). This cutting may be executed without the least danger to the health of the pulp if one is reasonably skilful and understands the relation of the lobes and developmental grooves to the pulp.

Figs. 1-3—(From Black's *Operative Dentistry.*)

The resistance form of a proximo-occlusal cavity is intended to provide a seat for the inlay, so that it will resist the stress of mastication. This consists of a flat seat, or seats, cut to definite angles with the surrounding walls. It is the opinion of the writer that much of the success or failure of the inlay depends upon the resistance form. Our attention has been called repeatedly to the splendid results obtained by many gold-filling operators, and it is not unusual to observe gold-foil fillings

[2] "A strict examination of ten thousand persons applying for dental operations in the clinic of Northwestern University Dental School discovered but nine persons in whose teeth decay had spread superficially, or on the surface of the enamel, across these angles." (G. V. Black, *Operative Dentistry*, II, 142.)

which have been giving excellent service for from twenty to forty years. Why? Are gold-foil fillings the only fillings which are permanent? Is the success of gold foil attributable only to its adaptability to cavity walls? Certainly gold foil, in the hands of a skilful operator working under favorable conditions, makes an excellent, durable filling; its adaptability to cavity walls is unsurpassed. But the writer is convinced that one of the most important factors in the success of gold fillings is the cavity preparation; that on account of the very nature of the material it is necessary to cut cavity walls to definite angles with flat seats. This facilitates the placing of the filling, to be sure; but its greatest lasting benefit lies in the degree of stability it gives to the filling—the stability that means permanence. If proper resistance form has increased the length of service of gold-foil fillings, in which case the most adaptable material known to our profession is used, how much more important it must be for us to study our resistance form when preparing cavities for gold inlays, where the final adaptation of filling to surrounding cavity walls is entirely by means of cement. The fact that the occlusal surfaces of inlays are carved in wax should mean the restoration of good marginal ridges. These ridges are subjected to the stress of heavy mastication by the inclined planes of opposing teeth, not now and then but repeatedly during each meal. To depend upon the flat pulpal wall alone for the resistance to this stress is not sufficient. If rocking and displacement are to be prevented and the marginal ridge is to receive the constant support it requires, the gingival wall should be flat and cut to definite angles with the buccal, lingual, and axial walls (Fig. 4).

Retention form is for the purpose of resisting tipping stress. We usually think of this form as an interlocking of the inlay with the tooth in the occlusal step; but nearly parallel walls afford frictional retention, and the resistance form, when properly provided, aids materially in preventing dislodgment. Such interlocking as is necessary can be gained readily in the deep grooves or fissures usually present on the occlusal surface, but if no imperfections are present, or if no grooves are in evidence, as may be the case in some well worn teeth, the dovetail should be cut in the position which these grooves would naturally occupy, were they present.

There has been considerable discussion from time to time about the amount of taper or inclination necessary for cavity walls as prepared for gold inlays. Dr. Ward[3] had stated that this taper should be from .10 to .25 inch per inch,

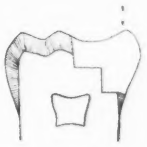


Fig. 4—Section of molar tooth cut mesio-distally in the axial plane. Arrow points to marginal ridge of inlay which should have the definite support offered by a flat gingival wall.

while other writers have usually been satisfied with a taper just sufficient to permit of the withdrawal of the wax pattern without distortion. Dr. Conzett[4] has even gone so far as to prepare inlay cavities with parallel walls as for gold fillings, and claims that the cavity preparation may be identical with the preparation of gold foil, if undercuts are eliminated. It seems to the writer that the middle ground is to be preferred. Usually, if a pattern can be withdrawn without distortion and the subsequent steps can be carried out with strict adherence to the fine detail of a satisfactory tech-

[3]Marcus L. Ward, "Factors of Importance in the Construction of Cast Gold Inlays," *Dental Cosmos*, LVII (1915), 522.

[4]J. V. Conzett, "The Gold Inlay," *Dental Cosmos*, LII (1910), 1341.

nic, the inlay will be a success. But in mesio-occluso-distal cavities, particularly in molar teeth, where the distance from the axial wall of the mesial portion to the axial wall of the distal portion is considerable, and the tendency of the pattern is to bind when removal is attempted, it seems advisable to have the axial walls well tapered in order to prevent distortion of the pattern.

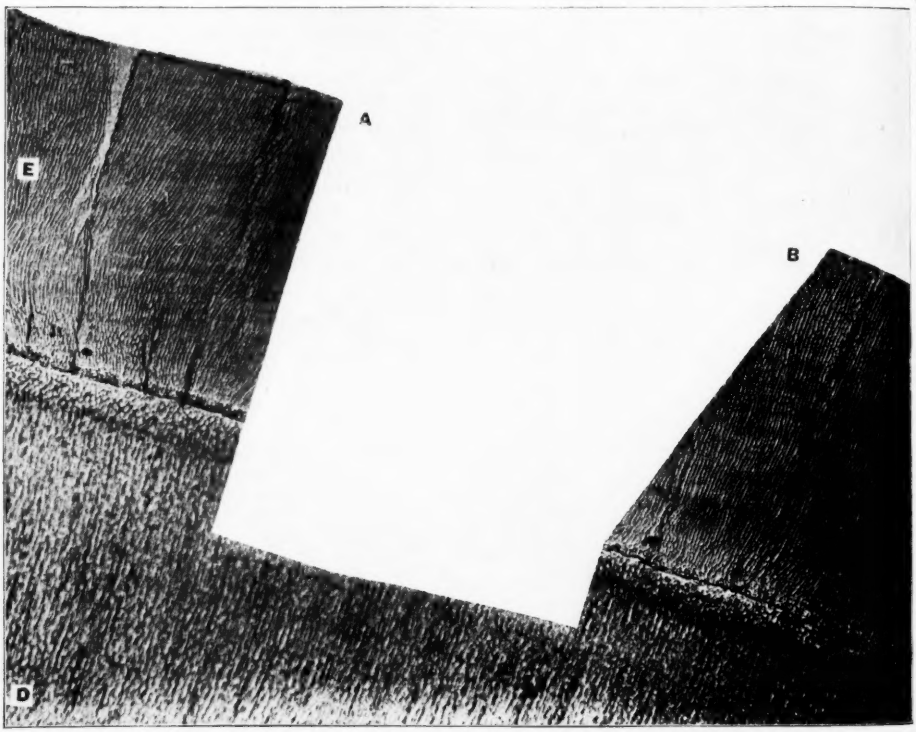


Fig. 5—A section of enamel thru which a cavity has been cut into the dentin. *E,* enamel; *D,* dentin; *B,* a strong enamel wall with a strong cavo-surface angle; *A,* an enamel wall cut in such a relation to the direction of the enamel rods that it would be very frail and liable to chipping without the bevel of the cavo-surface angle shown at *A*. With the bevel shown the wall is good. (From Black's *Operative Dentistry.)*

The preparation of the enamel wall should be made with the utmost care, certainly with as much attention to detail and consideration of the histological structure of the enamel as would be given were the cavity to be filled with gold foil. In the opinion of the writer, this practically eliminates the use of stones. Dr. Noyes[5] has laid down certain rules for the preparation of enamel walls which are applicable to cavities for all permanent fillings. These rules require that enamel shall rest upon sound dentin; the enamel rods which form the cavo-surface angle must have their in-

[5]F. B. Noyes, *Dental Histology and Embryology,* p. 80.

ner ends resting upon sound dentin; the rods which form the cavo-surface angle must be supported by a portion of enamel in which the inner ends of the rods rest on sound dentin and the outer ends will be covered by the filling material; the cavo-surface angle must be so trimmed that the margin will not be exposed to injury (Fig. 5). A strict application of these rules necessitates the use of hand-cutting instruments. It requires that the enamel shall be cleaved to determine enamel rod direction, which indicates chisels and hatchets; it requires that enamel walls be planed and beveled to insure marginal support, which further indicates hand-cutting instruments, including gingival margin trimmers (Fig. 6). Time will not permit of a thoro exposition of the subject in this paper; therefore, you are urged, if you have not already done so, to make an exhaustive study of the histological requirements previously referred to. It should be stated, however, that a bevel of the cavo-surface angle is not always necessary to the fulfilment of these requirements; nor is it always essential for a perfect marginal finish to an inlay (Fig. 5).

Waxes and their manipulation have most certainly received their share of discussion since the introduction of the disappearing wax pattern into inlay work. Since a good wax pattern is second only in importance to a good cavity preparation, this is not to be wondered at. From a review of the literature of this subject, it appears that there are two serious problems which must be met in pattern making. One is the ever-present problem of contraction; the other that of warpage. Some would add to these the danger of distortion upon removal; but with a properly prepared cavity and a wax which breaks before bending, when chilled to mouth temperature or lower, this danger should be eliminated. Dr. Van Horn[6] has concluded that cast pattern wax has a coefficient of expansion of about 1 per cent for every 20° rise in temperature. If this be true, and it seems probable, some means must be devised to compensate for this contraction or the inlay will not fill the cavity. Dr. Van Horn's plan is to expand the pattern by re-heating; but the danger of releasing the molecular tension (elasticity) is too great, according to Dr. Prothero[7] to permit of such practice. The technic which has been adopted by the section on wax patterns of the Dental Unit,[8] seems to minimize the danger from the two sources which have been referred to. Unfortunately the writer is unable to give credit for this method, which is applicable to proximo-occlusal cavities. A piece of stick wax is prepared into a cone-shaped piece by passing one end quickly thru the

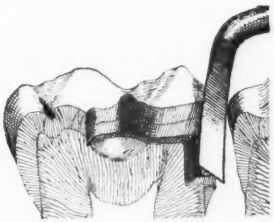


Fig. 6—The gingival margin trimmer in position giving a slight bevel to the gingival cavo-surface angle. Notice particularly the angle of the cutting edge of this instrument and its adaptation to this work. The pair of gingival margin trimmers designed for use in distal cavities serve equally well for that position. (From Black's *Operative Dentistry*.)

[6]C. S. Van Horn, "The Importance of Recognizing Temperature Changes and the Sequelae When Executing Cast Gold Inlay Technique," *Dental Items of Interest*, XLII (1920), 371.

[7]J. H. Prothero, *Prosthetic Dentistry*, p. 948.

[8]The term as here used, and elsewhere in this paper, refers to the G. V. Black Dental Unit of Northwestern University.

Bunsen flame and then, while holding the stick in one hand, pushing back the softened exterior with the thumb and finger of the other hand. This is done again and again until the cone of wax is soft on the outside but is hard and firm on the inside or core. The tip of the cone will be soft thruout. The hardened core acts as a plunger to drive the softened wax into the angles and against the margins of the cavity. When the cone is prepared, the excess wax is broken off and the point of the cone pressed into the gingival portion of the cavity. Pressure in one direction is continued until the entire cavity has been filled and the tips of the cusps are felt thru the wax by the thumb or finger for, say, a minute. The wax is then chilled with room temperature water. With a sharp instrument the excess wax is quickly cut away from beneath the bell-crowned portion of the tooth and the mass is lifted from the cavity with the thumb and finger, the bulk of wax which bulges out to the buccal and lingual being used as a handle. All margins are well protected at this time by excess wax. With a small sharp knife the proximal portion is cut to form, and the gingival margin trimmed so as to leave a very slight excess, which subsequently should be burnished against the gingival margin of the cavity. The wax is reinserted into the cavity and the pattern trimmed to form with suitable instruments, which should be cold. After all margins are burnished, the pattern should be chilled again with room temperature water and removed by means of a fine exploring tine. The pattern may now be immersed in a bath of room temperature water and invested when convenient. There are four items in the technic just briefly described which need some emphasis. First, the cone of wax must be so shaped that the tip will be pressed against the gingival wall first (Fig. 7) in order that as pressure is applied the wax may be condensed against the gingival wall. This should help to obviate the gingival shrinkage of which some operators complain. Second, the continued pressure upon the wax, as it cools to mouth temperature, tends to keep the cavity full and also condenses the wax. Third, the manipulation of the wax with cold instruments, trimming and burnishing, adapts the pattern to the cavity margins and aids in compensating for possible loss in volume by shrinkage. Fourth, chilling the wax with room temperature water and the maintenance of that temperature lock the wax in its new form and prevent distortion, which might take place

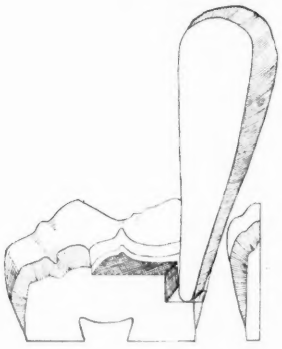


Fig. 7

were the temperature raised and the elasticity of the wax released. For mesio-occluso-distal cavities this technic is not so well adapted, and consequently a different technic is advised. The cavity must be prepared so that the crown of the tooth will not be any wider mesio-distally at or near the occlusal than it is at the level of the gingival walls; that is, all of the bell crown must be cut away. An adaptable matrix must be adjusted to fit the tooth, but not too tightly. The matrix is filled with wax somewhat softer than is commonly used; then the wax and matrix are forced over the tooth and cavity and pressure is applied over the whole mass with thumb or finger. This is held a moment or two, chilled with room temperature water, and

matrix and wax removed. The cavity surfaces of the wax are examined to determine whether the cavity has been copied accurately. If so, the matrix is removed and the pattern carved and trimmed as in the technic described for proximo-occlusal cavities. In case the cavity has not been accurately copied in the wax, it is best to make a new start with freshly softened wax.

The sprue former should be placed in such a position as to permit the gold, when cast, to flow readily to all parts of the mold with equal force. That is, in proximo-occlusal cavities, it should be placed so as to bisect the angle formed by the junction of the proximal portion with the occlusal portion of the wax; in mesio-occluso-distal cavities, it should be placed at, or near, the center of the occlusal portion. It is a good plan to remove the pattern from the cavity upon an exploring tine, place it in the hollow of the hand, heat the sprue former in the Bunsen flame while holding the metal in the naked fingers to prevent overheating, and to touch it to the pattern quickly and at the same time direct a mild blast of air upon the wax so that the sprue former is immediately affixed. The pattern should now be cleansed preparatory to investing. Washing the pattern with alcohol or soap water will remove mucus or oil, but temperature changes due to evaporation of these liquids from the pattern should be considered. The section on investments of the Dental Unit reports that the evaporation of alcohol from a wax-covered thermometer bulb caused a lowering in temperature of 13° after the expiration of thirty seconds and of 16° after sixty seconds. The same wax-covered bulb, washed with room temperature water, caused a change of 5° after thirty seconds and 8° after sixty seconds. These changes are not great but should be reckoned with if one desires to follow accurately the room temperature method. To obviate these changes due to evaporation of liquid-cleansing agencies, the pattern should be bathed in an excess of liquid—especially if alcohol is used—and then quickly immersed in a bath of room temperature water and left there until the investment material is mixed and ready for immediate application.

In order to insure an investment of uniform consistency, it is advisable to measure the investment material and water for each mix. They will also result in a saving of material. Both water and investment material should be used at room temperature. This uniform temperature can easily be had at all times if a bottle of water and a can of investment material are always allowed to stand side by side on the laboratory bench. Most investments in which silex and plaster of Paris are the principal ingredients should be mixed to a thick creamy consistency. The pattern should be covered with a thin film of material, using a sable's-hair brush as an applicator. The investment is painted on the pattern with a brushing motion toward the margins—not a stippling motion—in order to avoid the lodgment of air bubbles on the pattern or the entrapment of air on the cavity side of the wax. More material is applied until the entire pattern is thickly covered; then the ring is placed in position on the base and the investment poured into it until the ring is full. The ring should not be tapped while the investment is being made, as that may cause air particles to unite and form bubbles, some of which will settle on the cavity side of the pattern and result in nodules of gold on the inlay. After the expiration of fifteen or twenty minutes, the base and sprue former may be removed and dissipation of the wax should begin.

The object of heating the invested pattern is to remove the wax and leave a mold into which to cast molten gold. But the effect of heat upon the investment must be considered. Dr. Prothero[9] has stated that the binder in investment

[9] J. H. Prothero, *op. cit.*, p. 950.

materials is usually plaster of Paris, which "decomposes to a more or less extent at 190° C." or 372° F. Naturally this would vary with the quality of plaster used. Accepting this figure as approximately correct, it seems advisable to dissipate the wax at a temperature between 320° and 350° F. That this can be done has been adequately demonstrated. Several devices have been suggested to regulate the temperature during dissipation of wax.[10] Gas and electrically heated ovens have been used with equally good results. The section on investments of the Dental Unit has adapted a gas thermostat to an oven made of galvanized iron which can be regulated to maintain the heat at practically any temperature desired. Some dentists have used old vulcanizers. But a very satisfactory result can be obtained by placing the flask on a metal plate over the Bunsen flame. The flasks should be raised slightly from the plate to permit of the free circulation of air under them—a piece of wire screening will answer—and they should be at least partially surrounded by a metal shield as a protection against drafts. A few thermometer tests will determine how much gas should be used, and the gas cock can be opened to the same position each time.[11] The flasks should be placed in the oven, open end down, so that the wax can run out as it melts, and the temperature kept at 340° F. for an hour to an hour and a half, according to the size of the pattern. They may then be removed and before casting should be allowed to cool to room temperature. The advantages of this method of wax dissipation are these: The wax is not boiled out of the mold, with consequent injury to the surfaces of the mold by explosions of gas; the strength of the investment is not impaired by overheating; the mold is not distorted by excessive expansion of the investment; and the method is simple. Of the points mentioned, the strength of the investment is probably the most important. Dr. Prothero[12] states that "decomposition of the binder from overheating is largely responsible for the roughening and bulging outward of the matrix walls under the pressure of casting." Some writers, among them Dr. Lane,[13] have advocated rounded cavity angles because of the danger of the molten gold rounding sharp angles in the mold. The writer maintains that if the binder has not been overheated no angle is too sharp to be reproduced in the casting. The reproduction in the inlay of the very small hole made by the exploring tine used to remove the pattern from the cavity, has many times demonstrated the strength of the investment material after dissipation of the wax by this method.

Of the various devices suggested for casting inlays, none is without merit; but for casting molten, not superheated, gold into a mold which has been allowed to cool to room temperature a centrifugal machine should be chosen, since it will allow room temperature to be maintained in the mold and will cast the inlay quickly enough to reproduce accurately sharp angles. With such a machine there is no gas, air, nor steam pressure to cool the gold; it can be heated just until it spheroids and the surface is clear; then the cast can be made. It should not be heated longer or to a higher temperature. Longer heating will raise the temperature of the flask much above that of the room and will cause expansion of the mold, which in itself might not be undesirable were it not for the ever-present danger of

[10]R. H. Volland, "Casting Gold Inlays," *Jour. Nat. Dental Assoc.*, VI (1919), 425.

[11]The bulb of an ordinary vulcanizer thermometer may be invested in an inlay ring with the same investment material which is being used for inlays. This should be kept on the plate with the flasks and used as a guide to control the temperature until the amount of gas required to produce a temperature of 340° F. has been determined.

[12]*Op. cit.*, p. 950.

[13]J. C. Lane, "The Casting Process Applied to Gold Inlays," *Dental Digest*, XV (1909), 369.

distortion, which goes hand in hand with expansion. Superheated gold is the cause of many rough castings. Most of the centrifugal machines on the market today provide for the melting of gold in a crucible outside the flask. This is a very desirable feature. The casting section of the Dental Unit has given the writer the results of some very interesting experiments which were conducted to show the temperature of the mold at the time of casting. In all cases tried, the mold was at room temperature when fusing of the gold was begun and temperature readings were made as soon as the ingot (3½ dwt. of 22K gold) was in a condition to be cast. The experiments were not exhaustive, but were sufficient to show that if one desires to cast gold into a mold exactly at room temperature he should use a centrifugal machine with a shallow crucible set apart from the flask and a flame much hotter than any which a gas and air blowpipe will produce. With an oxygen blowpipe the ingot was fused and ready to cast in fifteen to twenty seconds, and the temperature of the flask was never increased more than 2° F. when the Volland centrifugal machine was used.

When the inlay is placed in the cavity, there will not be contact with the proximating tooth, as the wax contact was cut away while the model was being trimmed. Therefore the inlay may be forced into place immediately without much trimming, and it may be determined at once whether or not it is a success. As the higher carats of gold are quite soft it is necessary that the contact point shall be restored with solder to insure a permanently well-rounded contact point, one that will not be flattened by interproximal wear.

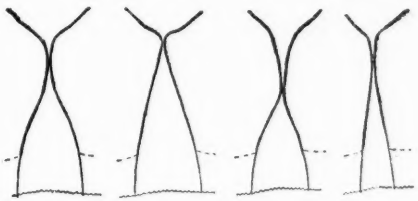


Fig. 8—Good and bad forms of proximal contacts, buccal view. The proper position of the contact point bicuspid and molar teeth is about as shown in *A*, just a little to the gingival of the marginal ridges. The convexity of both surfaces at this point should generally change to a slight concavity in the gingival direction. The position of the contact in *B* is too far occlusally. With such a form of contact, less than the normal portion of food will pass thru the embrasures, and the exposed portions of the proximal surfaces of the teeth will not be normally cleansed in mastication. The position of the contact in *C* is too far gingivally. The long approaches from the occlusal invite the wedging of food between the teeth, with the danger of forcing the contact open. The position of the contact in *D* is about right, but the teeth have not been separated to restore the normal mesio-distal width of the interproximal space. (From Black's *Operative Dentistry*.)

The form of the contact point should be smoothly rounded, and it should be placed in its normal position, a little to the gingival of the crest of the marginal ridge. Dr. Black has stated that the contact point should be as two marbles touching each other. This means that there should be a rounding away of the

proximal surface of the inlay in all directions from the point of contact. A great many contact points are placed so far to the occlusal that the margins of the filling do not receive the natural cleaning. For when the contact point is placed, say in a millimeter gingivally of the crest of the marginal ridge, the proximating marginal ridges are thrown farther apart (Fig. 8*A*), thus forming a larger opening between the inclined plans of the ridges, which will accommodate a correspondingly large amount of food. The food is separated by the contact point and forced thru the buccal and lingual embrasures by the cusps of the opposing teeth. Also the area not

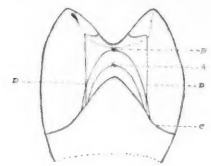


Fig. 9—Proximal aspect of an upper bicuspid. *A* indicates correct position of contact point, which is the same as *A*, Fig. 8; *B* indicates contact point too close to the marginal ridge as in *B*, Fig. 8; *C* indicates the position of the septal tissue. *D* indicates probable position of filling margins. Note the difference in size of the unclean areas as indicated by the curved lines running bucco-gingivally and linguo-gingivally from the contact points *A* and *B*. It will be seen that the filling margins are safer when the contact point is placed somewhat gingivally of the crest of the marginal ridge.

scoured by food will be made more narrow bucco-lingually and the margins of the filling will be more certain of being kept clean by natural means, if the contact point is in its normal position (Fig. 9). When the contact has been adjusted to proper form and tightness (Fig. 10), all the margins should be thoroly burnished by heavy hand pressure with suitable instruments before setting. After cementation, the margins should be finished with sandpaper disks and strips; but burnishing should not be resorted to on account of the likelihood of fracturing the hardened cement.

The value of the gold inlay as a means of restoring lost contour has been much discussed. Some men consider its utility in the restoration of occlusal surfaces its greatest worth. Certainly this is of great value; but the writer cannot agree with those men who believe that unless every line and wrinkle of the normal occlusal surface is reproduced in the filling, masticatory function is

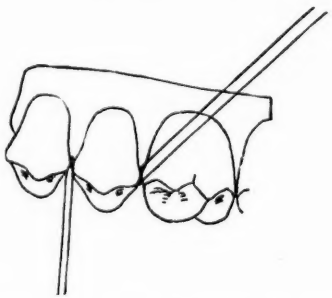
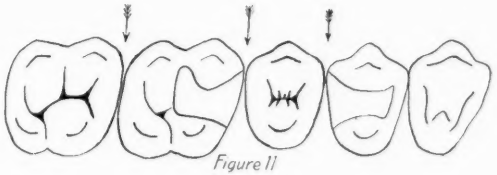


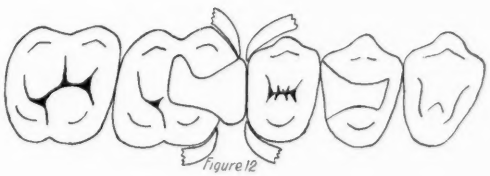
Fig. 10—In testing a contact the ligature should be first carried thru from occlusal to gingival, then the two ends of the ligature should be held paralliel in the occlusal direction, as shown between the two bicuspids; the distance between the strands will indicate the bucco-lingual width of the contact. The two ends should then be held parallel in the buccal direction, as shown between the second bicuspid and first molar; the distance between the strands will indicate the occluso-gingival width, of the contact. In either position, if the parallel strands are more than from 1½ to 2 mm. apart, the contact is too broad. (From Black's *Operative Dentistry.*)

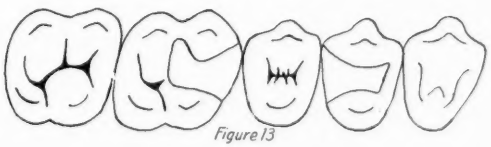
impaired. A proximo-occlusal filling, however, is nothing better than a plug for a carious cavity, unless full proximal contour with strong contact is restored. The fact that the gold inlay offers the easiest, surest and best means of restoring lost contour gives it a position in the first rank as a filling for cavities in these positions where there is danger

of injury to the gingivae because of impaction of food. Not only is it a simple matter to restore the contact between two surfaces, but frequently it is possible and practicable to restore several contacts on one side of the arch by a little over-contour of one inlay which may be driven into position subsequent to the movement of the teeth by slow separation.

It not infrequently happens that a patient presents with several fillings in the same region which may have been well done except for the very important matter of contact (Fig. 11). Or the lack of contact of one filling may have caused several teeth on one side to move apart just enough to allow food to crowd in thru the weakened contact points and press down upon the gingivae, causing annoyance to the patient and injury to the septal tissue. Such conditions, seriously threatening the health of the peridental membrane, may be greatly improved in many instances by the placing of one inlay. The Perry separator should be adjusted in one or more positions to determine which contacts can be







Figs. 11-13—Fig. 11, occlusal view of the upper right cuspid, first and second bicuspids and first and second molars. Arrows point to lack of contact or weak contact. Fillings in first molar and second bicuspid. **Fig. 12**, the jaws of the Perry separator are lifting the first molar and second bicuspid apart sufficiently to tighten the contacts between the first and second molars and the first and second bicuspids. Gutta-percha is shown packed into the first molar cavity after the removal of the old filling. **Fig. 13**, an inlay, somewhat over contoured, has been placed in the molar cavity. It holds the separation previously gained and restores three faulty contacts to proper tightness.

tightened (Fig. 12). Usually a filling can be removed and the cavity packed with base plate gutta-percha to hold the separation gained with the mechanical separator. If the teeth need to be moved a considerable distance, the patient may return several times and additional separation may be gained with each sitting. Finally, an inlay may be made which must be over-contoured somewhat and driven into position. This will tighten the contacts and frequently will remedy the cause of the gingivitis (Fig. 13).

To be sure, contacts may be tightened in a similar manner with gold foil or amalgam fillings, but the gold inlay seems to lend itself more readily to such operations. Occasionally, when teeth are moved in this manner, it will be necessary to grind one or more cusps a little, so that the contacts in the opposing arch will not be disturbed even by the slight change in conditions.

An attempt has been made to outline a technic for the construction of cast gold inlays which has proved in the hands of the writer and in the hands of others with whom he has been associated, good and workable. The results obtained have been superior to those obtained by any other method. It is not claimed that this is the one and only method, nor that inlays made after the manner described will be perfect every time a cast is made; but is *is* claimed that this reasonable, simple, and yet scientific method may be developed into a technic which will bring satisfactory results in a very large percentage of cases.

Discussion

Daniel H. Squire, Buffalo, New York: The longer we are engaged in dental practice the more we are impressed with the fact that many operations which are equally successful are made by as many different plans of procedure; yet the basic principles which this paper presents should be the foundation of these various methods. The age of the patient, the amount of decay present, the condition of the teeth relative to fractures, the reaction of the saliva, the tendency toward inflammation of the supporting structures, together with the general hygiene of the mouth, and the home care which the teeth receive are factors which will influence the outline, as well as the resistance form of the classes of cavities. In order to make the inlay safe against future dislodgment, and recurrent decay, cavities in general should always be made broad enough and deep enough to hold a sufficient amount of filling material to resist the stress of mastication; that is, the metal should be of sufficient bulk to be strong in itself, otherwise fracture will occur at the junction of the occlusal and the proximal portions.

The cavity formation which is advocated by the essayist both in regard to the shaping and the finishing of the dentin and enamel walls is most important, because the unseating of inlays and the fracture of enamel walls may be traced to narrow seats, indefinite angles, extreme divergence of the dentin walls, and to enamel margins with rods unsupported by dentin. Fractional resistance is a very important item, one which adds much toward the stability of the inlay, as it is retention in itself to quite a degree. Experience compels me to say that if these classes of cavities are prepared under the influence of anesthetics a review of dental anatomy in respect to the location of the pulp and of pathology in regard to the etiology of hyperemia and its possible results would not come amiss. The contraction of the wax pattern has been one of the principal features in the failure of inlay work, and the method of using a cone of wax will obtain a more perfect adaptation, as it is founded upon the same principle which is employed in the use of modeling compound in impression taking by the indirect method. Not all of the contraction of the material, however, takes place at the gingival seat, because it is equally apparent at the extremity of the occlusal portion of the cavity. I have used a full band copper matrix and found it of great assistance in confining the wax while it is being forced to place. The band is applicable to any tooth without separation, as it may be reduced in breadth to accommodate itself to the occlusal side of the contact point of the tooth on the one side and allowed to project just beneath the wall of the cavity on the other. It is also loose enough to permit the wax to pass over the gingival margin of the cavity, thus assuring a perfect adaptation. The wax and matrix are removed without danger of distortion. The narrow portion of the band is clipped with scissors and easily separated from the wax pattern after the wax has been trimmed, replaced in the tooth, and the occlusion practically determined. I believe it was Dr. Schayes who advocated the softening of the occlusal surface of the wax with a sufficiently warm burnisher so that

the patient could reproduce the relation of the inclined planes of the cusps upon the wax by oscillating movement of the jaws. This will give a perfect occlusion without changing the pattern in any way, because only the surface of the wax is slightly softened and the final burnishing may be done with cold instruments.

The same principles which are advocated by Dr. Blackwell relative to the shaping of the wax cone and its adaptation to proximo-occlusal cavities are also applicable to the mesio-disto-occlusal. It has been my practice to use two wax cones of suitable size, fastened together in a perpendicular relation, and with a full band matrix already fitted and adjusted about the tooth. The cones are warmed and forced quickly to place, the apex of each cone coming in contact with the gingival seat of the corresponding side. The wax is held in position until cooled and then removed. While I do not dispute the claims of the essayist for the merit of the large cone, it is my opinion that greater accuracy may be obtained with the use of two small ones. The essayist does not mention any particular investment material, but in order to bring the discussion to some specific point I may be permitted to refer to the Taggart investment, as it is the one with which I am more familiar. After this investment has been thoroly mixed, a small amount is poured upon a glass slab and the thin, watery portion transferred to a piece of paper, for the paper will absorb enough of the moisture to leave the investment slightly thickened and it can then be painted upon the wax without danger of its being disturbed when the rest of the investment is poured into the ring. There is less danger of entrapment of air when this method is employed. In the heating of this investment, a very low temperature is maintained for fifteen or twenty minutes, or until no steam or gas appears to be rising from the mold, and then it is subjected to a higher temperature until the investment is quite near the inner side of the ring. It is then removed from the fire and allowed to cool at room temperature.

My experience has been with the direct pressure machine of the Taggart type, and I am of the opinion that the investment need not be excessively heated during the process of casting if the gold is placed upon a charcoal block and brought to a high degree of temperature; it should then be transferred to the ring and the melting of the gold finished with an oxygen blowpipe. However, I am very much impressed with the technic which Dr. Blackwell has suggested for this part of the work.

The opportunity which is offered for closing open contacts, when restoring teeth to their normal forms is one of the most important items which has been mentioned in this essay. The investigations of Dr. Black and the articles which he has published regarding the contact of teeth show beyond a doubt that a lack of contact, or improperly placed contact points, are the very beginnings of disease of the septal tissues. The proper placing of the contact point is extremely important, as well as the proper contour of the proximal surfaces of the teeth to be restored. There are many large inlays made with very prominent contact points, but with such slab-sided proximal surfaces that the food is forced into the interproximal spaces just as freely as if no contact had been made. Inlay work is not a short cut over the malleted gold filling by reason of its technic, but on the other hand a most painstaking process of restoration.

Earle S. Smith, Iowa City, Iowa: For many years the dental profession prepared cavities for gold foil and for amalgam fillings in a variety of ways—one man made them one way, another man made them a different way—and it took a Dr. Black to standardize the technic and to present the scientific principles upon which all work of cavity preparation should be based. These principles have been largely accepted by the profession.

The history of the making of gold inlays has been very similar to the history of cavity preparation—one man has been making them one way, another in a different way—and as a consequence uniform results have not been obtained. On account of the careless, slipshod methods of some men, the gold inlay has received much unjust criticism. It has been the abuse and not the use of the gold inlay that has caused much of this criticism. If it were essential that there be a standardized technic based upon scientific principles for the preparation of cavities, to a like degree is it essential that a standardized technic for the making of gold inlays be adopted.

As has been suggested by the essayist with a few modifications the principles of cavity preparation, as laid down by Dr. G. V. Black, should be used as the basis for preparing cavities for inlays. One step not mentioned by the essayist but which should be done first of all is the examination of the occlusion. The making of check bites with wax and even in some cases the making of casts will often disclose points whereby the inlay may be curved to bring out the greatest amount of efficiency in the finished inlay.

The biggest factor in the retention of an inlay is the resistance form of the cavity. Even the dovetail made in the occlusal part of the cavity in the strictest sense is resistance form and not retention form; it is made to prevent the inlay from being displaced proximally and that displacement would be due to a force

acting parallel to the long axis of the tooth and toward the pulpal wall or toward the gingival wall. Many inlays have been failures because the gingival wall of the cavity has been concave instead of flat. Undoubtedly many of you in your youthful days out on the old farm used an old-fashioned wash basin. Some mornings after a good cold night you found that water had been left in the basin the night before and it was frozen solid. How did you remove it? You set the pan on the stove for a few moments then pushed downward upon one edge of the ice and the piece slid right out of the pan. Why? The resistance form of the pan was concave. Neither must the cement be relied upon to retain an inlay. An inlay cemented to place with an inferior cement but in a cavity having good resistance form has a much better chance to be a success than an inlay cemented to place with the best cement but in a cavity with a poor resistance form. It is absolutely essential that the walls be smooth, that the gingival and pulpal walls be flat, and that the other walls meet the pulpal and gingival at but slightly obtuse angles.

Dr. Blackwell has given some good suggestions about the manipulation of wax. In making form pressure must be maintained until the wax has cooled; otherwise the elasticity in the wax will cause it to draw away from the gingival wall. Another method for the manipulation of wax for mesio-occluso-distal cavities is to soften the wax similar to the way suggested by the essayist, pinch the softened end of the wax to a wedge form and then with a knife split the wedge so as to form two small points. After a slight reheating the wax can be introduced into the cavity, one point in the mesial portion, one in the distal, and a generous supply into the occlusal and the wax forced "home." For carving proceed the same as for a simple proximal. This does away with the necessity of using a matrix.

I do not agree with the essayist about leaving the wax form in water for any length of time. The sooner it is invested the least chance there is for distortion or for accidental breakage.

The things desired in a mold are that it be the same in size as was the wax pattern, that it have smooth walls, and that these walls be sufficiently strong to withstand the impact of the molten gold without being distorted. The dissipation of the wax is the point where many operators have failed. Excessive heat has spoiled many an inlay because the binder of the investment has been abused, leaving a mold with pitted walls and different in size from the wax pattern. A low heat, 370° F. or below for a long time is better than a high excessive heat for a short time.

By leaving the sprue hole down when the investment is on the fire, one takes advantage of all of the three ways that wax is dissipated—volatilization, melting and being absorbed by the investment, melting and running out of the sprue hole.

If a low degree of heat is desirable while the wax is being dissipated, then for the same reason the investment should not be subjected to high heat when the gold is being melted. casting should be done in a cold mold and with gold that has not been superheated.

A standardized technic if it is to be adopted by the profession as a whole and if it is to accomplish the most good must be simple and yet accurate and efficient. Dr. Blackwell has outlined a technic that requires no special high-priced equipment; it is a technic that no person with the average amount of skill will have difficulty in following and it gives accurate results; it is a technic that fulfils all of the requirements—simplicity, efficiency, accuracy.

Dr. Blackwell: I am glad that the discussers have given emphasis to some points. I should like to suggest that if any of you have not made a number of proximo-occlusal or mesio occluso-distal inlays for technic cavities you should make them. That is the only sure way to check up on your work. In the mouth, you do not always see every imperfection, especially when there is a slight deficiency at the gingival margin; but you do see them in the technic cases, and by continually working and improving your technic such imperfections can be overcome. I believe that all of us should do a great deal of this sort of work if we are to render our best service to our patients.

SPONTANEOUS NEPHRITIS IN RABBITS AND ITS RELATION TO CHRONIC NEPHRITIS IN MAN*

By E. T. BELL, M.D., and THOMAS B. HARTZELL, M.D., D.M.D., Minneapolis, Minnesota

IT IS well known that spontaneous[1] nephritis is often found in rabbits, and there are frequent estimates in the literature as to its frequency. There is, however, not much detail published as to the finer structure and pathogenesis of this lesion, and it is still a serious source of error for those engaged in the study of experimental nephritis. It is noteworthy that no investigator who claims to have produced a chronic nephritis experimentally has been able to draw a sharp distinction between the spontaneous lesions and those supposedly produced by the experimental procedure. This fact is usually admitted, tho sometimes ignored, and the argument is made that a lesion occurring much oftener in the experimental than in the control animals is due to the experimental procedure. It is not generally recognized that nephritis in animals (especially the rabbit) is entirely different in its pathogenesis from human chronic nephritis, and that therefore the successful experimental production of lesions of this character does not necessarily illuminate the problems of the etiology of human chronic nephritis. We have, therefore, thought it worth while to give a brief account of the etiology and pathogenesis of spontaneous nephritis and to call attention to its relations to the problems of human nephritis and experimental nephritis.

Frequency

Smith[2] found some renal lesion in 11 of 50 rabbits. Ophüls,[3] in a study of the kidneys of 50 rabbits, found 28 entirely normal, 9 with slight parenchymatous lesions, 3 with a few small areas of cellular infiltration, and 10 with "scattered small areas in which were marked interstitial lesions with formation of small depressions on the surface." Ghoreyeb[4] mentions a spontaneous lesion in 9 rabbits in an article in which 48 rabbits are recorded by number. Longcope[5] found lesions in the kidneys of 8 of 24 supposedly normal rabbits. Major[6] found that of "52 rabbits dead of natural causes, none had the extensive scarring of the cortex" such as was found in his experimental animals. Apparently Major was writing only of severe lesions.

In our own experience, which includes the study of over 200 rabbits over a period of two years, the percentage with spontaneous nephritis varied greatly

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[1]"Naturally acquired," suggested by MacNider, is a more accurate term than "spontaneous," but the latter seems to be in general use.

[2]Arch. Int. Med., 1911, 8, p. 468.

[3]Proc. Soc. Exper. Biol. and Med., 1911, 8, p. 75.

[4]Jour. Exper. Med., 1913, 18, p. 29.

[5]Ibid., 1913, 18, p. 678.

[6]Jour. Med. Research, 1917, 35, p. 349.

from month to month. Sometimes nearly all were found normal, but usually from 10-20% were diseased. There were two periods during the past two years, each lasting about 1 month, when over 80% of the rabbits examined had nephritis. The disease apparently assumes an endemic form at times. The animals used were purchased in large groups from different dealers, and it was noted that the disease was much more prevalent in some groups than in others when they were first put into the animal house. Many rabbits developed nephritis after they came into our possession.

In view of the great variations we have noted, it seems unsafe to conclude, as Longcope and others have done, that a given lesion is due to the experimental procedure merely because it occurs oftener in the experimental than in the control animals. The source of the animals used as controls and the length of time they are kept in the animal house are very important factors.

Etiology

We have attempted to isolate bacteria in eight cases of spontaneous nephritis by removing pieces of the kidney aseptically immediately after the animal had been killed, or from the living animal under ether anesthesia. The pieces of tissue were put in plain broth or in dextrose broth. Signs of growth first appeared in the medium after several days' incubation. Four of the cases gave no growth. In two cases we obtained a gram-positive staphylococcus in pure culture. These organisms when first isolated were very virulent—¼ c c of a broth culture being a fatal dose for a rabbit. The third subculture, however, was practically avirulent.

In two other cases pure cultures of streptococci were obtained. These grew feebly and did not cause death or infection when inoculated into rabbits. We did not succeed in reproducing nephritis by injecting normal rabbits with the organisms obtained from any of the diseased kidneys. In the absence of this evidence the organisms isolated cannot with certainty be regarded as the etiologic agents; but it seems to us a highly probable assumption. They can hardly be due to contamination since the growth did not appear until after several days' incubation, the organisms were in pure culture, and in two instances were very virulent. It is known to us that streptococci have often been obtained from the tissues of rabbits, but these have usually been from animals that died slowly from natural or experimental disease where the opportunity for agonal invasion was present, and not from animals killed and cultured directly. Dr. W. P. Larson of this laboratory tells us that he has repeatedly found the normal kidneys of rabbits sterile.

Pathological Anatomy and Genesis

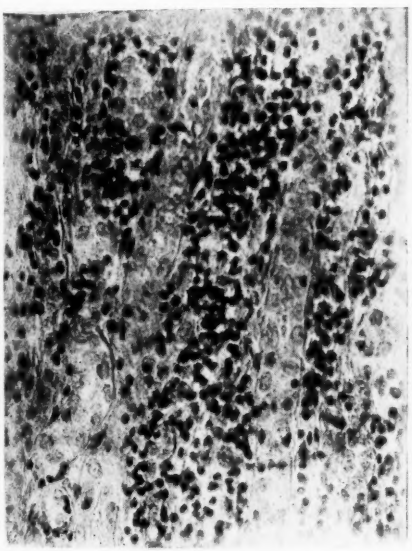
For the sake of clearness we shall discuss this topic without special reference to observations recorded in the literature. In the earliest stages small foci of lymphocytes are found usually near the cortico-medullary junction but sometimes elsewhere in the cortex. There are only a few of these lymphocytic foci in mild cases—many sections of the kidney may be entirely normal. But in severe cases these areas are numerous, and they may fuse to form extensive areas of infiltration. The lymphocytes are of intermediate size and lie for the most part closely packed between the tubules, but a few invade the epithelial cells (Fig. 1). At this early stage there are no gross changes on the surfaces of the kidneys. In severe cases the cut surface is clouded. Albumin is present in the urine except in cases where the foci are few and small.

The pressure of the exudate soon causes atrophy and disintegration of the parts of the tubules involved in the lymphocytic foci, and the destruction of

these tubules is responsible for the changes that occur subsequently. The first gross changes noted are the appearance of a reddish or purplish spot on the surface of the kidney overlying the lymphocytic focus. Later on this purplish spot gradually sinks and a distinct funnel-shaped depression develops in its place. In the final stages the pit may be as deep as the thickness of the cortex. When the surfaces are studded with such deep pits the kidney assumes a shrunken scarred appearance (Fig. 2).

Microscopic sections thru the purplish surface spot before the pit has developed show an early stage of atrophy of the cortical tubules belonging to the tubules destroyed in the lymphocytic foci. The atrophic tubules are smaller and more darkly stained than the normal, and their lumens are small or completely obliterated (Fig. 3). As the atrophy progresses these tubules become gradually converted into narrow epithelial cords, and in the final stages even these have disappeared entirely. Sections thru pits such as are shown in Fig. 2 show complete atrophy of the tubules, but the shrunken glomeruli are easily identified (Fig. 5).

The tubules atrophy from the lymphocytic focus to the tip of the medullary pyramid as well as toward the surface of the kidney. This is easily seen by the study of serial sections of such a kidney as is shown in Fig. 2. The scar



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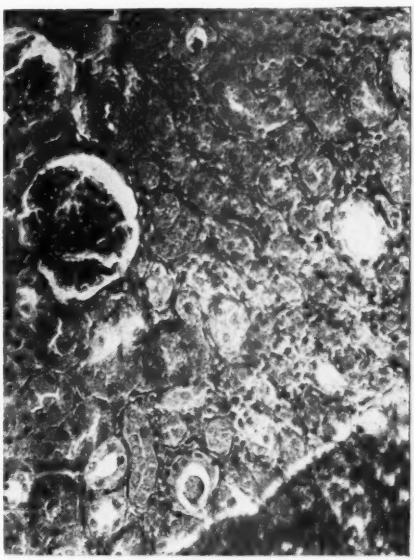

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Fig. 1—Photomicrograph. Area of lymphocytic infiltration at the cortico-medullary junction. Some tubules are already destroyed. This is the earliest type of lesion in spontaneous nephritis.

Fig. 3—Early stage of atrophy of convoluted tubules due to destruction of their corresponding collecting tubules in a lymphocytic focus at the edge of the medulla. (The tubules in the lower left hand part of the figure are normal.)

is readily traced from the surface pit down thru the medulla to the tip of the pyramid. In the medulla it stands out very prominently as a band of tissue from which the tubules have disappeared (Fig. 4). The end-result of the lymphocytic infiltration at the cortico-medullary junction is the formation of a wedge-shaped scar with its apex at the tip of the pyramid and its base at the surface of the kidney. The lymphocytes usually occur only near the center of the wedge. That this is the shape of the lesion can be determined in any case by the study of serial sections.

We are not dealing therefore with a diffuse interstitial nephritis such as occurs in diphtheria and scarlet fever, but with discrete lymphocytic foci which cause atrophy of the entire tubule system by destroying its central portions. In severe cases where the foci fuse the appearance of acute interstitial nephritis is simulated.

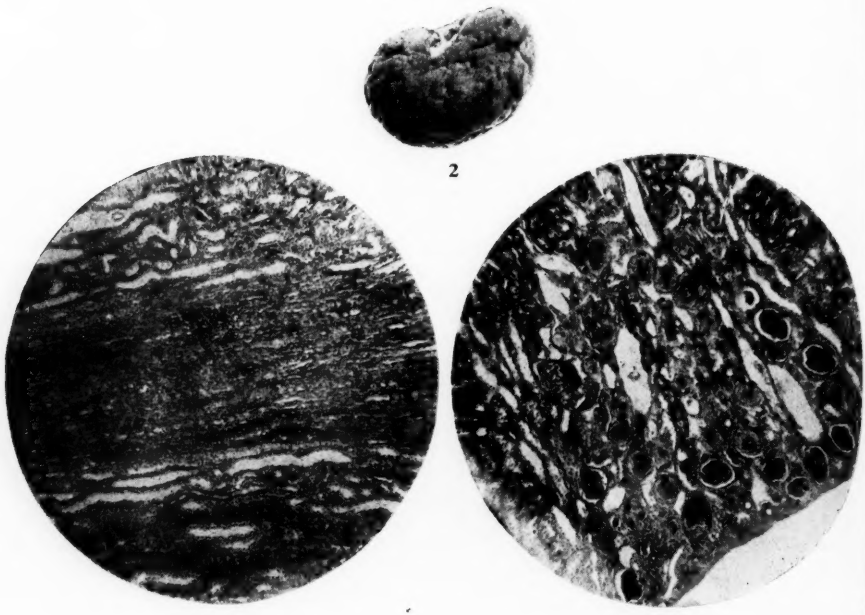

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Fig. 2—Photograph. Kidney showing numerous deep pits due to atrophy of cortical areas. The atrophic areas were produced by lymphocytic infiltrations at the cortico-medullary junction.

Fig. 4—Scar in medulla. This was traced in serial sections and found to connect with a surface pit such as is shown in Fig. 5.

Fig. 5—Cortical pit (scar) showing complete disappearance of all the tubules. The glomeruli are still present. This is a healed lesion.

The gross appearance of the kidneys in the late stages depends on the number of lymphocytic foci originally present. There may be only 2 or 3 pits, or the pits may be so closely set that the kidney has a shrunken contracted appearance. These severe extensive cases have given rise to the view that spontaneous ne-

phritis in the rabbit is comparable to the contracted kidney of man, but this is not a correct interpretation. The most common form of chronic nephritis in man is a glomerulo-nephritis in which the primary injury is to the glomerulus, and the atrophy of the tubule is subsequent to the destruction of this structure. In the human arteriosclerotic kidney areas of tissue, of small or large size, undergo atrophy because of sclerosis of the nutrient artery. In spontaneous nephritis in the rabbit neither of these conditions obtains, but the atrophy results from destruction of a part of the tubule by an inflammatory exudate. The only form of human nephritis in any way comparable to rabbit nephritis is a form of focal infection in the kidney characterized by abscesses or diffuse inflammatory areas, and due to hematogenous infection. It is often referred to as "excretory" nephritis, or excretory pyelonephritis when the infection passes on into the pelvis of the ureter.

It is clear, therefore, that the successful solution of the problem of spontaneous nephritis in the rabbit will not necessarily throw any light on the problems of human nephritis. As far as we have observed spontaneous nephritis in animals other than the rabbit is similar to rabbit nephritis, but we have not studied other animals extensively enough to warrant a general statement. Le Count[7] described a case of chronic glomerulo-nephritis in a rabbit, and MacNider[8] reported this form as common in dogs. The important problem for experimental pathology in this connection is the production of a chronic glomerulo-nephritis.

Spontaneous nephritis frequently results in recovery. This is especially true in cases where the infection is not very extensive. Albumin disappears from the urine and the functional test is normal, but the pits on the surface persist. There is no attempt at regeneration of the scar tissue. In many cases, however, there is a progressive destruction of renal tissue. Death usually results from toxemia and intercurrent diseases rather than from renal insufficiency.

Urinary Findings

Albuminuria is usually demonstrable in the active stages of the disease. It may be intermittently present in mild cases, and it disappears entirely after healing. This last point is of considerable importance in experimental work. We have found deeply pitted and scarred kidneys at operation in several animals which had normal urine and normal phthalein excretion just before the operation. The presence of albumin in the urine does not necessarily mean that the rabbit has nephritis of the type described above. Our records show seven animals with albuminuria in which necropsy revealed only slight tubular injury in the kidney, the cause of which could not be clearly established. It is well known that albuminuria may be produced by a large variety of renal irritants. Casts are not constantly present.

Renal Function

The phenolsulphonephthalein test shows no change except in severe cases. The lowest 2-hour excretion we have recorded is 20%. When the phthalein test was reduced to any considerable degree extensive renal involvement was always present. Healed cases gave a high excretion, even tho the scarring was considerable.

Development of Nephritis in Control Animals

We have records of two rabbits with normal urine in which exploratory operation showed the surfaces of the kidneys smooth. These animals were kept as controls for some other experi-

[7] Jour. Infec. Dis., 1914, 15, p. 389.

[8] Jour. Med. Research, 1916, 34, p. 177.

ments. About three months after the exploratory operation they were found to have developed a typical spontaneous nephritis. This observation is of great importance in interpreting experimental results. It is easily possible for nephritis to develop during the course of long experiments independently of the experimental procedure.

Another type of lesion occasionally seen has been described by several authors (Le Count,[7] Fig. 11, p. 402). It consists of a wedge-shaped area composed of dilated tubules with flattened epithelium. We have not worked out the genesis of this lesion.

Associated Lesions

In all cases of spontaneous nephritis there was an associated lymphocytic infiltration of the portal connective tissue of the liver. This chronic hepatitis is also present in many cases in which the kidneys are normal. About 75% of the livers examined by us (50 cases) showed portal infiltration in varying degrees. Organisms may usually be cultivated from these livers but they do not always correspond with those obtained from the kidneys.

We did not make an extensive routine examination of the heart muscles in our nephritic cases; but in three rabbits in which large numbers of sections of heart muscles were examined we found foci of lymphocytes similar to those described by Longcope[9] and attributed by him to the action of foreign protein. It is probable that this form of myocardial infection is frequently associated with spontaneous nephritis.

Relation of Spontaneous to Experimental Nephritis

There has been no confusion of spontaneous with experimental acute nephritis since the two lesions are entirely different; but the natural disease has seldom if ever been sharply differentiated from chronic lesions supposedly produced by experimentation. As indicated in preceding paragraphs no observer has offered any convincing evidence that the lesion supposedly produced differs anatomically from the spontaneous disease. In fact, the illustrations accompanying many articles correspond entirely with the appearances of the natural disease. The usual argument is that a lesion occurring much oftener in experimental than in control animals must be due to the experimental procedure (O'Hare;[10] Dickson;[11] Christian, Smith and Walker;[2] Longcope[12]). But other explanations of these results are possible. 1. A spontaneous nephritis may develop during the course of experiments lasting several months. The control animals were not kept in the laboratory for the same length of time under the same conditions. Klotz[13] admits this as a possible source of error in his work. 2. The use of renal irritants such as uranium nitrate may favor the development of an infection in the kidneys, because of the general lowered resistance caused by the drug or because injured renal tissue is more susceptible than normal. The investigators who used uranium did not make cultures of the kidneys to see if bacteria were present. We obtained a growth of bacteria from one uranium kidney.

Observers who apparently did not examine the urine at the beginning of each experiment, and there are several in his group, are open to the criticism that the animals may have had nephritis at the outset of the experiment.

When virulent bacteria were injected into the blood stream, as in the experiments of Le Count,[7] Klotz,[13] and Hartzell and Henrici[14] it is easily

[9]Jour. Exper. Med., 1915, 22, p. 793.

[10]Arch. Int. Med., 1913, 12, p. 49.

[11]Ibid., 1909, 3, p. 375.

[12]Jour. Exper. Med., 1913, 18, p. 678.

[13]Trans. Assn. Am. Phys., 1914, 29, p. 49.

[14]Jour. Am. Med. Assn., 1915, 64, p. 1055.

possible that they are entirely responsible for the resulting lesions. One would expect a lesion resembling spontaneous nephritis from this procedure. The acute glomerular lesions obtained with streptococci suggest a relationship between these organisms and human glomerulonephritis; but the other lesions which various experimenters have attributed to injected bacteria bear no anatomic resemblance to the human disease.

Summary

Spontaneous nephritis in the rabbit is a subacute or chronic infectious disease characterized in the early stages by lymphocytic infiltrations in the kidneys usually at or near the cortico-medullary junction.

The parts of the tubules included in each lymphocytic focus undergo atrophy, and subsequently there is atrophy of the tubule systems both proximally and distally to the lymphocytic foci. The end-result is the formation of wedge-shaped scars with their apices at the apex of the pyramid and their bases formed by pits on the surface.

In our experience nephritis is much more common in some groups of rabbits than in others. The sanitary environment seems to be important. The disease is especially apt to develop in animals kept in the laboratory for several months.

Albuminuria is present in the active stages of the disease, but is absent in healed cases. Unlike human chronic nephritis many cases recover.

The investigators who believe they have produced chronic nephritis experimentally have not had controls adequate to exclude the spontaneous disease, and the lesions described correspond closely with spontaneous lesions.

No chronic glomerulo-nephritis has been produced experimentally. There is no anatomic or pathogenetic relationship between spontaneous nephritis in the rabbit and human chronic glomerulonephritis.

FUNDAMENTAL LAWS GOVERNING PARTIAL DENTURE CONSTRUCTION

By E. E. BAILEY, D.D.S., Denver, Colorado

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

AT THE outset I wish to state that I do not claim originality for the theories and principles set forth in this paper.

Complete diagnosis must in all cases proceed the prognosis. An accurate set of study models showing the position and inclination of the remaining natural teeth and the shape and area of the alveolar ridges is imperative. Clinical examination of the remaining teeth and mucosa overlying the alveolar ridges is of paramount importance. A complete set of X-rays should be made not only of the remaining natural teeth, but also of the edentulous areas. This is an adjunct which, in the light of the present-day knowledge of focal infection, cannot be dispensed with. The history of the physical condition of the patient may be of benefit in diagnosis. With the data in our hands we will be able to diagnose the case scientifically and can arrive at the proper prognosis and proceed in a systematic way with the restoration of the case.

Clinical experience has proved that partial dentures which will limit atrophy of the alveolar structure, and give maximum masticatory function, and not prematurely destroy the remaining teeth can be produced only by a balanced effort between alveolar ridge and abutment teeth, thereby producing the maximum support; further, by limiting stress-giving area to two bicuspids and one molar, thus increasing the ratio of stress-bearing area to the maximum; and finally by perfecting the occlusion and articulation.

To further suggest the necessity for such an appliance, aside from the utilitarian and aesthetic requirements, I wish to present the following: At the New Orleans meeting in 1919, Dr. George Monson, of St. Paul, called the attention of the dental profession to the danger of a closed bite producing a retrusion of the mandible, causing the head of the condyle to encroach upon the auditory mechanism, with its possibility of deranging acoustic function. Dr. Wright, of Pittsburgh, reports investigation along the same lines which corroborates Dr. Monson's contentions. If the arguments presented by these gentlemen are correct, the type of cases that would cause this condition, to the extreme, are those cases in which the mandibular molars and bicuspids have been lost, leaving the incisors pitted against the inclined planes of the upper anterior teeth, thereby producing not only a closed bite but also a forced retrusion of the mandible.

This means that we should produce an appliance that will re-establish and

maintain the correct anterior-posterior position of the mandible. If appliances are to re-establish and maintain the proper anterior-posterior relation of the mandible, we must incorporate the principles of a co-ordinating action between alveolar ridge and abutment teeth.

In order to discuss the fundamental laws underlying the construction of partial dentures, we must deal with the most difficult cases we are called upon to treat, namely, the extension type. Once we have mastered the difficult cases we will readily find a solution to the simpler problems in the field of partial dentures.

In all of our procedures, we should never lose sight of the fact that the human mandible is tremendously powerful and capable of all the movements of a universal joint; therefore it is essential that we should recognize the lines of force delivered by it in the many positions of incision and mastication, and also the lines of bearing which absorb the stress delivered.

Direction of Force Delivered by Mandible and Location of Bearing Areas

Let Figure 1 represent a cross-section thru the region of the first molar of a maxilla and mandible in the position of a lateral masticatory movement of the latter. As the mandible closes the inclined planes of the teeth engage and guide it into central occlusion, delivering force parallel with line *A*. Line *B* represents a space where food is caught and crushed, which crushing creates force in the same direction as indicated by line *A*. Line *C* represents the line of bearing which necessarily should be at right angles to the line of force. It should be at once apparent that during lateral masticatory thrusts the direct bearing area on the maxilla is located from the crest of the ridge to the buccal periphery of the base, and on the mandible from the crest of the ridge to the lingual periphery of the base. The area of the ridges parallel with the lines of force during lateral masticatory movements acts only as a stabilizing influence. As the stroke is completed the line of force changes until the inclined planes of the teeth are in occlusion, as indicated by Figure 2, at which time the heavy crushing force is applied and stress is delivered in a line parallel with the long axis of the teeth, indicated by line *A*. The direct line of bearing should be at right angles to the line of force. However, the wedge-shape of the alveolar ridge necessitates a V-shaped bearing, indicated by line *C*; therefore in this position the bearing area is over the entire circumference covered by the base.

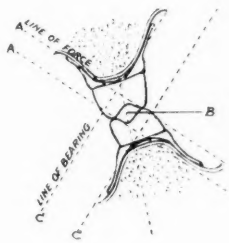

Fig. 1

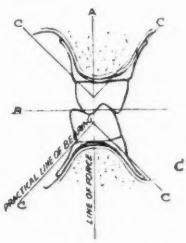

Fig. 2

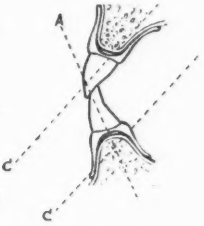

Fig. 3

Figure 3 is a cross-section of a denture thru the region of the central incisors. During incision the line of force is represented by line *A*, and the line of bearing by line *C*. The direct bearing area on the maxilla is from the crest of the ridge to the lingual periphery of the base; on the mandible, from the crest of the ridge to the buccal periphery of the base. The study of lines of force and of bearing areas during the different movements of the mandible points out two things. First, it teaches that during certain incisive and masticatory movements only a portion of the area covered by the base is pitted directly against the stress, reminding us that in all cases we should use as large bases as the case will permit. Second, it calls attention to the shape of the alveolar ridges and the fact that they are covered with compressible tissue, which means that when force is applied the base will move a little before the mucosa is compressed to a density where it will do work. Therefore the necessity arises for large bases to be well adapted and held snugly against the mucosa so that when force is applied the movement of the denture will be only the compression of the mucosa to a density where it will withstand the stress.

To produce a base capable of thoro adaptation, that is, taking a definite seat, equally distributing the stress of mastication delivered to underlying tissues and limiting the settling of the case to the minimum, it is of paramount importance to secure the proper type of impression.

Impression

An impression is indicated which compresses the tissue buccally and lingually, or, as it were, labially and lingually, and relieves the crest of the ridge and other areas as indicated. Figure 4 represents a cross-section of an impression. A method for securing such an impression is to conform a No. 20 gauge tray metal over a cast made from an ordinary impression, designing it to the form necessary to make the base, indicated by *A*. Fill with a thin layer of compound and force to place; chill, remove, and trim periphery to desired form (*B*). Next trace a lower fusing compound on buccal and lingual flanges (*C*), and just as it chills to a temperature where it will still take a sharp impression, but offers a little resistance, force it to place and make an impression of the buccal and lingual mucosa under pressure, being sure to relieve the crest of the ridge slightly by not causing the two bodies of compressing compound to flow together. The finished impression should resemble *D*.

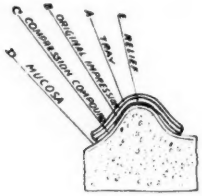

Fig. 4

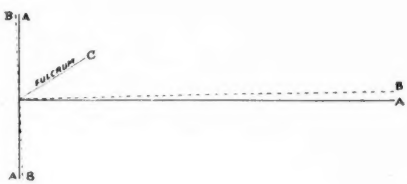

Fig. 5

Attachments

The fundamental requisite for an attachment is that it must be applicable without unduly mutilating teeth. It

must hold the base firmly against its seat but should nevertheless be capable of slight mobility to free the tooth from torsal and lever stress. When used where exposed to view it must be capable of taking a design which will not display a large amount of metal. The various forms of the case clasp seem to come within the realm of a practical attachment. However, at times we have to deal with teeth which require extensive restoration. Here some form of internal attachment would perhaps be indicated. We should never unduly mutilate teeth for the sake of applying internal attachments.

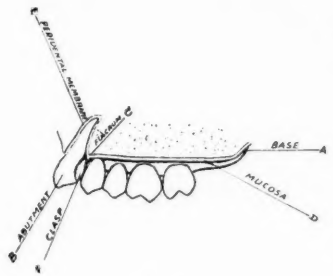

Fig. 6

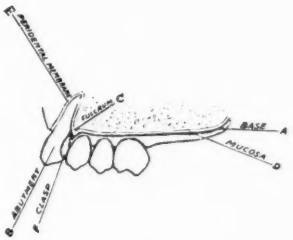

Fig. 7

Relationship of Base to Mucosa When Impression Is Taken to Unite Base to Attachment to Facilitate Building Into the Case the Principle of Presettlement

As far as my knowledge goes, I consider that for extension cases the relationship of base to attachment must always be established directly in the mouth. The base should be firmly seated, slightly compressing the underlying mucosa at which time plaster is applied, to establish the proper relationship to the attachment.

Let Figure 5 represent a cantalever, the horizontal line *A*, the base of the denture, the perpendicular line *A* (prime) the tooth, line *C* the fulcrum which would correspond to the peridental membrane and alveolar process at the distal gingival of the tooth. Where force is applied on line *A* its approximate movement is indicated by the dotted line *B*. It is at once apparent that such a motion of line *A* would cause the crown of the tooth to be tipped distally and the apices of the root to be thrown anteriorly, causing an inflammation and in time destroying the investment of the tooth, an experience we have all had in the types of rigid extension appliances where correct impressions and proper relationship of base to alveolar ridge were not obtained.

Figure 6 will stand as a fair example of a horizontal section of a case supplying the teeth posterior to the cuspids. *A* indicates the base, *B* the abutment, *C* the fulcrum, and *D* the mucosa. The base fits snugly and extends over a large area. The attachment to the cuspid is a semi-rigid mesio-distal grip clasp. When biting force is applied in the region of the first and second molars the movement of the base will be determined by the mucosa, which will have to be compressed before it will withstand the stress applied. The greatest movement of the denture will be at the posterior

periphery of the base, which is the point farthest removed from the fulcrum. The movement of the abutment will be practically nil, even if it were held rigid to all movements of the base. However, the means of attachment between the base and tooth is a semi-rigid clasp which frees the tooth from direct stress. A means of still further cutting down the cantalever effect of the base on the tooth is illustrated by Figure 7. The second molar is omitted, the effect of which places the stress nearer the fulcrum and materially increases the area of the base posterior to the teeth supplied from which the force is delivered. The effect will be that the base will carry practically as much stress as a molar tooth would carry at the posterior abutment. The points I wish to make are: (1) the maximum base should be used, (2) the attachment to the tooth should co-ordinate with the base in receiving the stress of mastication and should be resilient to free the tooth from direct stress, (3) the supplied teeth should be only those which the patient needs. The result will be that the cantalever effect of the base upon abutment teeth will be reduced to the minimum and the movement of the supporting teeth will be practically within the realm of their own natural movements.

Occlusion and Articulation

The teeth supplied should possess as long cusps as the case will permit and should be perfectly occluded and articulated. I do not mean the word "perfectly" to imply that in all cases we can establish anatomical perfection, but I do contend that in all cases we can and must work out the occlusion and articulation so that in all incisive and masticatory movements there will be no undue interference. A partial denture which has been perfectly constructed up to the point of occluding and articulating the teeth will surely not only destroy the teeth and alveolar ridge which support it, but in many cases will destroy the natural organs which antagonize it, if the occlusion and articulation are not perfected. The method for correcting the occlusion and articulation is to do the rough work on the articulator and then carry the denture to the mouth and further grind in occlusion by the aid of articulating paper and stones, final perfection being obtained by having the patient chew fine carborundum powder until no point of undue interference can be felt in any of the movements of the mandible.

HARMONY IN THE SELECTION OF ARTIFICIAL TEETH FROM THE CHROMATIC POINT OF VIEW

By KENT KANE CROSS, D.D.S, Denver, Colorado

(Read before the National Society of Denture Prosthetists, Boston, Massachusetts, August 20, 1920)

WE GET the word "harmony" from the Greek *armonia*, meaning joint, proportion, concord. It has been carried thru the Latin and French to our modern English in almost its original meaning. The *Century* and *Oxford* dictionaries define it as follows: "Any arrangement or combination of related parts or elements that is consistent or esthetically pleasing"; and the *Standard Dictionary* says that harmony as applied to art is a normal state of completeness in the relations of things to each other.

Louis Weinberg tells us in *Color in Everyday Life*, which work Dr. Williams recommends for the study of color, that color harmony refers to the pleasure which the eye and mind take in certain combinations of hues, whether in nature or in art. Thus the eye and mind are stimulated agreeably, as are the ear and mind to the chords of music. Weinberg says that "harmony is the goal of all endeavors; all that is desirable in life, whether it be objects or moods in rational living, as in beautiful expression, there is a binding force holding together contrasting elements and interests."

In speaking of the harmonious fitness of things, Hayward says in *A Lesson of Appreciation* that appreciation comes as a sudden flash, or a subtle dawn; and Browning sweetens the same thought when he says,

> There's a sunset touch,
> A fancy from a flowerbell
> Some one's death—
> A chorus-ending from Eurypides.

Whether it be in nature or in art, we have but to look about us to appreciate the harmony of things visual, both as to form and color scheme. The limitations of the aesthetist are responsible for the fact that art, however manifested, does not usually reach us in a perfect state; nor does nature always appear at her best. The rigor or seasons may mar the beauty of that which would have been a symmetrical forest, or a hailstorm may beat down a beautiful field of columbines.

Shall ye not, as dentists, as prosthetists, devote ourselves to diligent study and become to an acceptable degree, aesthetists? Should we not expect our dental colleges to teach the rudiments of aesthetics including a groundwork in chromatic harmony? After years of practical experience, we realize that all subjects involved or problems to be solved cannot be covered in a college curriculum; yet in the four years now required

shall we not give the foundation and inspiration necessary to develop the future doctor of dental surgery into an aesthetist?

The harmonious in form, the symmetrical in arrangement, the pleasingly proportional in size, and the harmoniously blended coloring as found in nature at her best should be our inspiration along aesthetic lines, but our real stimulation for achievement is the artless selection, if selection it may be called, of substitutes for the natural teeth. It requires but half an eye to recognize the crude choosing at random in denture work as we find it.

There are few of us who have not been confronted with those of our former patients whose appearance we have changed almost to the point of disfigurement.

Formerly we were handicapped by the lack of properly shaped artificial teeth, but for several years we have had molds that produce substitutes very close to the natural in form. From the color point of view, we have been at a disadvantage in that all teeth in the same set were of the same hue. Only recently a salesman showed me some full sets of teeth having the striated surfaces similar to our most acceptable manufactured teeth. I called his attention to the color which was the same thruout the entire length of the teeth, from the central incisor to the second molar. He said that it was the first time the matter had been brought to his attention, that he would mention the criticism to the manufacturers. Dr. Clapp emphasized the result of such an assemblage of one-colored artificial teeth, namely the effect of a mouth full of teeth.

Our failures have been as much errors in size, surface regularity, form and arrangement as in color, but I will deal only with the color scheme, except where other disharmonies affect the chromatic scheme.

The sensation of color is manifested by the division of light into its component parts, presumed to be due to a difference of wave lengths, violet and red rays being the extremes which affect the retina, ultra-violet and red rays not affecting the sight; and the peculiar phenomenon is that an object that appears red only causes the absorption of all but the red rays, which are reflected. Analogous colors modify the color effect of one of the colors; contrasting or complementary colors exaggerate the effect.

Chromatic harmony is of two kinds, analogous and contrasting. The harmony of analogy may be observed in nature in the various shades of green of luxuriant growth; moss, ferns, grass, evergreen, and leaves of deciduous trees, all of a similar, restful coloring, to which may be added the green covering of certain birds, reptiles, and insects. Contrasting harmony is illustrated by the profusion of mountain flowers, red, yellow, pink, pale blue, and the deepest purple with a background of evergreen trees and grayish brown or red rocks. As distance becomes greater, it will be observed that nature seems to blend all colors into one, as the deep blue of the distant mountains, or the lighter blue of the sky or sea. To some degree the same is true in the balance or blending of our scheme in the coloring of teeth. The red of the lips and the yellow of the skin suggest an orange hue. The dark oral cavity, and in the brunette type, the skin, hair and eyes, give more of the neutral gray or brown effect.

In harmonizing the color scheme when artificial teeth are to be placed between natural teeth, remaining natural teeth are to be our principal guide. But we are considering here only the edentulous mouth. While our problem may be some-

what perplexing, yet it has its compensations. The natural teeth may have been discolored by tobacoo, or so-called dentistry, and thus have become out of harmony with the complexion; or excessive exposure to the elements may have tanned the face so that the natural teeth have appeared too light.

These inharmonious effects can be corrected where all teeth are to be replaced. It is sometimes wise to reproduce stains in the former case to satisfy the patient, and it may be best to match the teeth that by comparison have become too light, in the latter instance. But that is a matter of expedience, an attempt to effect mental harmony, not harmony of hue.

The natural teeth having been lost, the skin is most to be considered in our effort to harmonize the artificial substitutes to the surroundings. We take it for granted that our work is with the Caucasian races, but if it were not we would endeavor, in the darker races, to a modified degree to harmonize teeth to the pigmentation of the skin.

In the blonde type, however, we can almost carry out a scheme of true analogous harmony. If the patient has hazel eyes instead of blue, we have a true example of similarity.

In selecting a suitable "shade" (which in my opinion would be more appropriately termed "hue" and our guide called the "hue guide") the tooth or teeth used for selection should be moistened and shaded (here properly used) in a way similar to that in which they would be in the denture. When in doubt the darker is usually the better selection, because there is less translucency and less probability of staining in the substitute teeth, and as the hue in the natural teeth becomes darker as age advances, the darker hue will become a better one as the years go by. My reason for suggesting "hue guide" instead of "shade guide" is that hue has to do with the distinctive qualities of colors, while shade suggests producing a shadow, or at best a gradation of a color in regard to intensity, as a dark shade, and tint refers to the blending of a color with white or a light color.

If in doubt as to the better of two hues, they should be placed side by side in the mouth, then placed successively. Thus we get simultaneous and successive contrast. One method of determining the most suitable hue is to look past the tooth and face. If unduly attracted to the teeth, it is inharmonious with the features. Another point to remember is that as the eye tires quickly, a quick or "snap" impression is usually the correct one. It is well also to have at hand more than one "shade" or hue guide, and to send the guide tooth selected to the supply house with the order. Bakings vary, not only in the sets prepared for the market, but also in the guides for selection.

If we take the orange hue as a basis to work from, we find in the red-haired blonde some pink. Going down the scale to the flaxen-haired, or extreme of the blonde type, little coloring is to be found in either the hair, skin, or teeth, only a suggestion of yellow. With the brunette type where contrast predominates but does not necessarily cause a clash in the color effect, we find that our suggestion of orange is modified by neutral colors, such as brown and especially gray. Gray is peculiarly the compromise between the white *of* the skin (here I do not say that the skin *is* white) and the brown of the eyes and the dark brown or bluish black of the hair.

The study of colors and the *practice* of harmonious selection are to be commended to the progressive prosthetist. "Eternal diligence is the price of lib-

erty"—"the truth" in art "shall make us free."

The high lights, the receding arch, and the shadows of the lips and of the oral cavity behind the teeth, the interdental spaces with their consequent shadows are all important factors. The redness of the lips gives the effect of a slightly blue-green to the exposed teeth; and where the skin is dark or where the dark oral cavity is exposed the effect is to exaggerate the contrasting colors.

To one who makes a study of chromatology, I believe the chief difficulties that will arise in making fine distinctions in the selection of proper hues will be from the fact that the structure of live dentin with its vascular pulp is so different from the mineral, colored as it may have been with studious care in the artificial teeth, that exact matching is impossible. This handicap, and that of the necessary rubber or metal attachment at the back of the substitute, render our work of chromatic harmony a real problem.

In conclusion, harmony is that arrangement which brings different elements into a pleasing combination, permitting an unexplainable appreciation; chromatic harmony is an agreeable stimulation of the eye and mind, chromatic harmony as found in nature and art is our inspiration; but our stimulation for advancement is our failures to harmonize the substitute teeth to the individual supplied; the sensation of color is caused by the division of light into its component parts and the absorption of all those parts except the color shown, which is reflected; analogous colors reduce intensity; contrasting colors exaggerate intensity. The blonde type illustrates analogy, the brunette, contrast; with the edentulous patient, the skin is first to be harmonized; our guide would be more properly called a hue guide; quick judgment is usually most accurate; in the dark complexion neutral coloring is prominent; the high lights, shadows of the interdental spaces and oral cavity and lips and the receding arch all affect the chromatic scheme; and our greatest handicaps are the necessary attachments and the difference in structure between the natural and the artificial.

THE COLLEGES' RESPONSIBILITY IN IMPROVING THE PRACTICE OF PROSTHETIC DENTISTRY

By W. F. LASBY, D.D.S., Minneapolis, Minnesota

(Read before the National Dental Association, Boston, Massachusetts, August 23-27, 1920)

THIS paper deals with the question of the dental colleges improving the practice of prosthetic dentistry, by teaching the subject in an adequate manner to students, by giving courses for the training of mechanic assistants for dental offices, and also by offering extension courses to dentists, who desire further instruction so that they may be better qualified to render the service expected of them by their clientele.

A change has been taking place in the practice of dentistry. Available data, altho somewhat incomplete, tend to show that in the past three years there has been an increase of approximately 80 per cent in the demand for full dentures and more than 100 per cent in the demand for partial denture restorations. This is indicative of the increased time and attention required of the dentist in this branch of his practice and of its increased importance to the whole profession. Much of this increased demand, it must be noted, is not due to neglect or carelessness on the part of our patients, but it is due to the failure of the restorative work which we have done for them, which has proved to be unsound in principle, because of the pathological conditions developed, and mechanically defective in execution. These same patients, with mouths partly or wholly edentulous, are again appealing to us for relief from the unfortunate condition in which they find themselves and for which we are in part responsible. Furthermore, it seems very probable that a period of from five to ten years must pass before this wave of increased denture demand due to the removal of foci of infection from the mouth subsides and we return to the normal increase in the demand for this service. This situation should arouse in us a desire to make a thoro study of the shortcomings of denture service as now practiced and stimulate us to find a solution to the difficulties with which we are meeting. Here and there we find men who are serving their clientele well and we all may at times feel a bit of justified pride in the results we are getting. Yet it is evident that as we talk with dentists we find that they seem more concerned about the success or failure of this branch of their work than they formerly were, and some of them are looking forward to the time when there will be no more dentures to be made or when there will be some one else in their community who will do the work for them. Then, too, the patients are better informed in regard to what can be done for an edentulous mouth and are more exacting in their demands for artistic and efficient restorations.

With these considerations before us, then—the increased demand for dentures, the better informed and more exacting patients seeking our service, and our responsibility toward them as a profession—to whom shall we look for help in trying to improve our denture work if not to the colleges? They are the

already established agency in every section of the country for the teaching of dentistry and for research work in the problems that come up for solution. If these colleges are to prove true to the purpose for which they exist they will prove equal to the task imposed upon them in this work and the results will justify our confidence in them. It is around these colleges that we believe the leaders of this work should rally and carry forward the educational work in an effective manner for both students and dentists.

Our educational problem is to adjust the courses of study to meet the constantly changing requirements of practice. The colleges have advanced from a three to a four-year course. The five-year course is already announced by one university. The probability is that we shall become a specialty of medicine and have a four-year course leading to the degree of Bachelor of medicine and follow it with a course of two or three years to prepare for any one of the specialties of medicine, including that of dentistry. It is during this period of rapid transition that we should especially seek to preserve a rational curriculum in dental subjects. Let us see to it that sufficient time and training is given in technical branches to develop in the student that degree of skill and judgment so essential in the execution of restorative and replacement work in the mouth. More skill is now required of the dentist in his operations on vital teeth to preserve them, to maintain the soft tissues of the oral cavity in a healthy condition, and to safeguard the patients' health than we formerly required. Therefore in planning a rational course of study we must not forget that as we lengthen the years of study sufficient time must be allotted to the training of the eye and hand and not permit all the additional time to be used in the theoretical subjects of the course.

What shall we expect of the colleges in the teaching of prosthetics to students? The first requirement is that they shall provide a sufficient number of trained teachers to give personal instruction to every student in the class. A lecturer may reach the ears of a large class and hold their attention in covering the didactic phases of the work; a demonstrator may show a fairly large group how a certain piece of technic should be done; but when it comes to the actual doing of the work in an intelligent way as regards detail and perfection, every student requires personal instruction of an intensive type. Such attention can be given by a teacher to a group of from ten to fifteen in technic courses and about eight in the clinical work. There is no substitute for the active, enthusiastic, effective teacher who gives to every student the help needed without delay in the work of the college. Not all colleges are so provided with teachers. Some expect an instructor to teach prosthetic technic to a class of fifty, or seventy-five, or even more, and it is absurd to expect that it can be done in any such manner. Every student should receive personal attention and we as a profession should require our colleges to provide a sufficiently large number of trained teachers to meet the requirements of the students in this respect.

The next requirement is for fully equipped laboratories with individual bench units, well lighted and ventilated and kept in a thoroly clean and sanitary condition. No teacher can permanently overcome the handicap of a poorly lighted, dirty, untidy room which breaks down the morale of the class and fails to stimulate the students to do their best work. The modern laboratory should be comparable to the modern operating room, thoroly prepared for the purpose it is to serve and a stimulus to everyone to do his best work.

After the question of teachers and laboratories comes that of what constitutes a course in prosthetic technic. The keynote should be adequate training for

present-day methods of practice and the abandonment of old or obsolete pieces of technic and methods. Our present need in this work is a standardized technic covering all phases of the work. It should be complete, comprehensive, and yet simplified so that in a busy office all details aside from the actual operations at the chair can be delegated to an assistant of moderate training and intelligence. It is vitally essential in the conduct of a practice that production be upon a sound basis financially. Prosthetic dentistry in many offices is done at a loss because the dentist himself does not know the cost of producing a denture; he makes the mistake of contracting to give a patient a satisfactory result without a thoro knowledge of the mental condition of the patient, his attitude toward the work to be done, and an understanding of the mouth conditions involved. When we add to this a haphazard slipshod technic of denture construction made by the dentist, by his assistant, or by a commercial laboratory, we have a combination of possibilities for professional and financial failure. The solution can come only from the educational side. The dentist must be prepared while in college to thoroly understand and diagnose mouth conditions for denture work and have a standardized, simplified, accurate technic to be followed by himself and assistants in order to put production on the correct side of his ledger account.

In addition to lectures and demonstrations and study of the properties of the materials used in the work, it is our teaching practice to have in laboratory pieces of technic work showing in detail every step of the work required, from the beginning to the finished product, so that the student has a visualized and tangible idea of what he is to do. As each step of the work is completed it is inspected and the student's card checked by the instructor. We know how fast each student is progressing, that he is doing the work himself, and that he understands what he is doing. Mistakes are easily discovered and corrected, and a wholesome rivalry is developed in the class as the students note the progress made by each other. As the finished work is placed on exhibition before the whole class no student willingly wants a defective piece to be seen by his classmates.

The training of mechanic assistants for dental office laboratories should include the same technic as that given to dental students and where adequate teaching instruction is given, one year is found to be sufficient to cover the work in all technic branches required to prepare them for office positions.

As a profession, we have technic systems with names attached, we have systems without names or where names have been forgotten, and we have methods without number, all have merit, some are good and some not so good. All are short of the ideal. What the colleges need to teach at the present time is not methods and systems but a standardized technic, founded on a thoro knowledge of the tissues of the oral cavity involved and the physical properties of the materials used in the construction of the denture. Why should this not be done? Human mouths present very much the same conditions in all parts of the world where dentistry is practiced and there is no reason why a technic used in one locality is not applicable to any other. Cavities to be filled with gold foil vary in size and form and yet the operation is more successful when the work done conforms to established procedures. In like manner gold inlay cavities are different, but the inlay fits the cavity better when a standardized technic of making the wax model, investing, burning out, and casting the inlay is followed than when a haphazard method is used. Likewise a standardized prosthetic technic gives better results. We would have had it long ago if we could

have agreed on details. We overemphasize certain details and forget to build a complete structure in our enthusiasm over some newly discovered angle of the problem.

We are glad of the progress recently made to produce an articulator for universal use. The selfish hope of gain and fame on the part of men who have been the leaders in the work has delayed the development of the instrument. The movements of the human mandible do not present different aspects in different locations; thus our problem is not one of meeting local conditions but the bringing together of localized methods and systems and the establishment of a standardized technic. Colleges may then teach it to qualified students of dentistry in suitably equipped laboratories, and after their graduation the profession will be honored by receiving into its ranks men who will be a credit to the healing art of dentistry.

Why should the colleges of the country not teach denture prosthesis on such a basis? The need is apparent to everyone who has studied the situation as it exists at the present time. As a profession we have a right to expect it. If any colleges fail to make progress it is because their vision of the educational ideal is eclipsed by the hope of financial gain, which they have before them as the reason for their existence. The most unfortunate feature of dental educational work in this country today is that there are institutions where financial returns to the owners of the enterprise seem to be the chief reason for their continuation. Except for a few headliners their faculties are hopelessly inadequate to do effective teaching, their classrooms and laboratories overcrowded and poorly equipped, and the whole situation depressing to those who are vitally interested in the future progress of our work. We should be profoundly grateful for the survey of the war educational board which classified the colleges of dentistry for us and called attention to the conditions under which some of them were existing. Dental education should be handled without thought of financial gain to any institution and can be adequately taught to meet present-day requirements only in colleges fully equipped and supported by outside financial aid.

The other phase of our problem is to aid the dentist already in practice and offer him the opportunity to keep up with the progress of the profession by means of intensive courses of study in any branch which he may choose to take. This opens the subject of extension courses and it is here that the colleges have an opportunity and an obligation to fulfil in their educational work. Some have vitally interested themselves in the problem and have made a creditable beginning and we bespeak for their honest endeavors the whole-hearted support of the profession.

We are familiar with the attractive announcements so frequently received of courses to be given by individuals or societies purporting to give instruction in almost any branch of dentistry. We wish that we might bespeak for such courses our approval, but we cannot do so. The earnest, studious, hard working, conscientious dentist, with high ideals of service for his clientele, who seeks to improve himself, gains from such courses an inspiration to perfect his technic and returns a better student and practitioner. For this type of dentist we can see some justification for such courses. What about another type? We regret to say that they exist and that there are more of them than there should be. We refer to those whose aim in the practice of dentistry is primarily to get the most income for the least effort and who sell their product at all times with that end in view. Can you become a specialist in local anesthesia and dental surgery by watching some one else do that kind of work for a few days? And yet you know men who are posing as specialists

in oral surgery after just such training. The public and the true advancement of dentistry is suffering in consequence of such methods.

A thoro course in the theory and practice of any specialty is the only type of postgraduate or extension course of study which should receive the approval or sanction of any college or dental society. No other satisfactory pedagogical method has ever been devised to meet the needs of the case. Dentists may be enthusiastic and stimulated by other methods, but not educated and trained to properly qualify them for the work they may wish to do.

The University of Minnesota has for sometime admitted graduates who wished to pursue studies in any branch of dentistry, but no certificate of any kind is granted except as the work could be applied toward a degree in the graduate school. Extension courses are offered to classes at stated intervals and the work has been well received. Three prosthetic courses given under the direction of Dr. M. M. House, of Indianapolis, Indiana, have shown that men are waiting for the opportunity to do some real work in denture prosthesis. We find that four weeks is required for dentists taking their first course. A staff of one director and four assistants is required for a class of twenty-four in order to teach the work in a satisfactory manner. The first week is devoted to lectures and demonstrations. The second week the men go into the laboratory and construct a technic case carrying out in detail, under careful instruction, the accurate and scientific technic shown in lectures and demonstrations. During the third and fourth weeks the practical work is done for patients, ample time being used so that each one studies and observes the various and difficult conditions present in the mouths of all the patients. After having had two courses of four weeks each, 43 per cent of the men registered for a two weeks' continuation course. The work is just getting started and presents almost unlimited possibilities. Most of the men taking the courses thus far are general practitioners and not prosthetic specialists. They represented nineteen states and the Dominion of Canada. It does not seem to be a question of location, time, or expense, but it was evident that they were earnestly seeking for a chance to improve their practice of denture prosthesis. Men of this type are to be found in every community and the opportunity for them to register for extension courses of instruction given in an adequate manner should be offered by every dental college in the country.

Fully equipped and endowed colleges of dentistry, trained teachers to give personal instruction to all students, a scientific technic of denture construction, extension courses of real value to dentists—these are the essential factors in the improvement of denture prosthesis at the present time.

PROFESSIONAL SUCCESS[1]

By HARRY LEVIN

WE ARE entering the threshold of a worthy profession. Let us look about us with our eyes wide open. Success is within our grasp. We must reach for it. Those who work and strive can grasp it. Set your goal high and then aim for it.

Initiative is imperative. We must plan a course of action and then go ahead with it, step by step. We must not sit back and expect some one else to lead us all the time. Success comes to those who take the initiative. Keep pushing, be thoro in your work and master every detail.

Let patience be our watchword. Success does not come without knowledge. If a thing does not develop in the way you expect, do not lost faith. Study it over and find the reason for the failure. There is a cause for everything, and having found the cause of the failure you will avoid making the same mistake a second time. There is an old saying, "If at first you don't succeed, try try again." That means perseverance. Then there is another one which is to this effect. "Everything comes to him who waits." To this I would add provided he works intelligently in the meantime. The sun always shines after a rain, and so after long, patient, and intelligent toil success comes to reward your efforts.

Intelligence is demanded in all our work. We must bring into use the things we have learned. The person who does not take time to think things over necessarily makes many mistakes. Let us spend a little time in thinking over the problems of our work and frequently advise with others. By so doing we not only obtain the benefit of others' experience, but develop our own thoughts and ideas.

There are certain other things which lead to success. Chance may be a stepping-stone toward it but it will never keep there one who does not justly deserve success.

The dentist who builds up a practice must believe in certainties. It is certain that the dentist who understands and applies sound principles will have far greater success than the one who guesses or imitates. It is also certain that the dentists of tomorrow are the dentists of today. They are reaching out and acquiring broad, well-balanced business and professional knowledge.

Success is also based upon the quality of mind and its training. There is no limit to its development. Rome was not built in a day. It is by steady grind that one gains success. The dentist who works half-heartedly, never giving a minute's more time for study than his work requires, can never hope to be a success. Each day we should ask ourselves, "How much more information have I today than I had yesterday?" Some people think that to be successful one must have luck. Indeed this is not

[1]Read in the seminar course, Senior year, 1920-21, College of Dentistry, University of Minnesota.

true. To those people I would say "to be successful" means "to persevere." No person has ever gained success except by honest diligent work.

Enthusiasm is another important factor of success. We must be enthusiastic about our work and surroundings. If we are not, no one will be. This enthusiasm on our part must be transmitted to those with whom we are associating. Pep is what counts. We must inspire those about us with it.

Honesty is also a great factor in success. By this I do not mean putting one's hands into the other man's pocket. I mean here "honesty of purpose." Give your patient the right advice. Do not tell him he needs a crown when an inlay is the proper thing for the restoration of the tooth. Make your decision by the actual needs of the tooth, and not by what the patient will pay. In other words, "Do unto others as you would have them do unto you." Be just. Give to every man that which rightly belongs to him and take from no man that which is not rightly yours.

There are several other factors which we must consider if we wish to gain success. Personal appearance and cleanliness of office is essential. If a patient comes into an untidy looking office, what do you suppose he thinks of the dentist? He thinks him untidy and immediately he asks himself these questions: "Is this man's work as untidy and uncertain as his office? Shall I have my work done here or go elsewhere?"

Efficiency is vital. By this I mean not only efficiency of work but efficiency of mind and body. To work efficiently we must be bodily efficient. The question arises how can we make ourselves bodily efficient? Here the subject of proper exercise enters. We should exercise regularly every day. It makes no difference what kind of exercise it is except that we must like it and enjoy it. It helps to keep our minds open and free and tends to strengthen us physically. Good health is thus insured and an atmosphere of good health is radiated thruout the office and to the patients, and makes them feel more at ease.

Closely associated with exercise is diet. If we eat too much our stomachs are overtaxed. The result is that an abnormal amount of blood is necessary to take care of the excess of food. Thus there is a subnormal amount of blood left to circulate thru other parts of the body, which causes a lowered resistance. When in such a condition we cannot do work efficiently. We are too drowsy. Overeating causes drowsiness.

Attention is also another stepping-stone toward success. We must love our work and then the impossible becomes possible. We must always be on the alert and ever attentive. Time waits for no man. Every day there is something new to be learned and we should grasp the opportunity. We must have faith in our work and then ability will follow.

Education is another essential point in the gaining of success. Beecher gives a very good definition of education. He says: "Education is the knowledge of how to use the whole of one's self." The dentist should concentrate his time and energy on the best that is in him. The way to conquer difficulties is to work them out. Let us subject ourselves to self-analysis. If we find we have limitations let us keep within them. If we have unused powers let us develop them. If we have defects let us eradicate them. If we feel we are capable of greater things let us attempt them. If we have an education it is ours. No one can take it away from us. We have study clubs, societies and the like in our midst, let us make use of them. They are for us and the furtherance of our profession. It is our duty to help make our profession a better one.

In closing this treatise, I might sum-

marize by saying that man himself determines whether or not he is a success or failure in his profession. To be successful one must be efficient. Success comes to those who work and strive. Good health, habits, loyalty and kindness are potent factors making for success. Yet cannibals and animals have good health and fairly good habits, but they lack one thing with which man is blessed. It is religion. Religion bears the same relation to success that water and sunshine bear to a plant. Life is wonderful. It is a series of surprises. It holds a penalty for every wrong and a just reward for virtue and wisdom. Recognize the divinity of your life, and commune each day with your creator that He may lead you, a loving, lovable and true man, a man among His men.

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VARIATIONS IN THE HYDROGEN-ION CONCENTRATION IN UNINOCULATED CULTURE MEDIUM*

By LINWOOD G. GRACE, D.D.S., and FLORENCE HIGHBERGER

From the Research Institute of the National Dental Association

WITHIN the last few years, the methods of adjusting the reaction of bacteriologic culture mediums have undergone considerable change. Titrating, using phenolphthalein as an indicator, has been shown to be almost as inaccurate as the older method of using litmus. A faint shade of pink was considered the neutrality point but it was difficult for even experienced workers to determine accurately this point. Further, it was almost impossible for one worker to duplicate another's results. It is possible that many discrepancies found in the results of different investigators may be due to this fact.

The newer method of adjusting the reaction by determining the hydrogen-ion concentration more nearly approaches the ideal than anything yet advanced and is fast finding its way into all bacteriologic laboratories. By this method the reactions of different batches of mediums can be more carefully controlled.

While making a study of the rate of acid production by Strep. viridans[1] some interesting facts concerning the broth used were brought to light.

Briefly, our experiment was this. The same strain of Strep. viridans was grown simultaneously in broth, the composition of which was the same, but the initial reaction was varied between PH 6.4 and PH 8.0. We then made observations on the rate of acid production with the idea of determining the reaction which favored most rapid growth.

This procedure for making up mediums is the one usually followed, it being assumed that the change produced in the reaction by the final autoclaving would be so slight as to be disregarded.

For the experiment in question we felt, however, that it was necessary to have an exact knowledge of the H-ion concentration of the medium just before it was inoculated. Careful tests were accordingly made to determine this. We also kept uninoculated tubes of the various reactions in the incubator and noted their reaction at the conclusion of the experiment. These control tests brought out the fact that the reaction was not as stable as we had once supposed. Not only would the final autoclaving produce a change, but the reactions also varied from day to day.

In an effort to determine whether there were any consistent changes or whether the reaction would finally reach an equilibrium, we carried out four tests.

Batches of the medium were made up at different times, under conditions as nearly identical as we could make them, according to the procedure given. Some of the tubes of each reaction were put in the incubator at 37 C., some in the icebox and some allowed to stand at room temperature. Each day the PH value of one tube from each batch was tested. Numerous checks served to show that the reaction of one tube was practically the same as that of others of that same set at that particular time.

A part of the same medium was put in flasks and kept under similar conditions in the incubator, in the icebox and at room temperature. Each day a definite amount was removed by sterile pipettes and the reaction noted.

*Reprinted from Jour. Inf. Dis., 1920, 26, No. 5.

[1]Jour. Inf. Dis., 1920, 26, p. 451.

TABLE 1

RESULTS FROM ONE TEST

1% Glucose Broth			Medium Stored in Tubes									Medium Stored in Flasks							
Initial Reaction Given Mediums	Reaction after First Autoclaving	Reaction after Final Autoclaving	*	Reaction after Standing One Day	Second Day	Fourth Day	Sixth Day	Seventh Day	Eighth Day	Ninth Day	Tenth Day	First Day	Second Day	Fourth Day	Sixth Day	Seventh Day	Eighth Day	Ninth Day	Tenth Day
PH6.4	PH6.4	PH6.4	R.	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.4	PH6.3
			Inc.	6.4	6.3	6.3	6.4	6.4	6.4	7.2	6.3	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
			I.B.	6.4	6.6	6.4	6.5	6.4	6.4	6.4	6.6	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
6.8	6.8	6.6	R.	6.8	6.8	6.8	6.8	7.2	6.5	6.6	6.8	6.8	6.8	6.8	6.8	6.6	6.6	6.6	6.6
			Inc.	6.6	6.8	6.8	6.6	6.6	6.6	6.4	6.8	6.8	6.8	6.8	6.8	6.6			
			I.B.	6.8	6.8	6.8	6.8	7.2	6.6	7.0	6.8	6.8	6.8	6.8	6.8	6.6	6.6	6.6	6.6
7.2	7.0	7.2	R.	6.6	6.3	6.3	6.3	6.3	6.4	6.4	6.5	7.1	7.2	7.0	7.0	7.0	7.0	7.0	7.2
			Inc.	6.6	6.3	6.3	6.5	6.4	6.4	6.4	6.3	6.9	6.9	6.9	6.9	6.5	6.9	6.9	6.9
			I.B.	6.5	6.4	6.3	6.3	6.4	6.4	6.3	6.3	7.1	7.2	7.0	7.0	7.0	7.0	7.0	6.9
7.6	7.2	7.3	R.	7.4	7.4	7.4	7.4	7.4	7.3	7.4	7.3	7.2	7.2	7.3	7.2	7.0	7.0	7.2	7.0
			Inc.	7.4	7.4	7.3	7.4	7.4	7.3	7.4	7.3	7.3	7.0	7.0	7.0	6.6	6.9	6.9	6.9
			I.B.	7.4	7.5	7.4	7.4	7.4	7.3	7.4	7.3	7.3	7.2	7.3	7.2	7.0	7.0	7.2	7.0
8.0	7.8	8.0	R.	7.0	7.0	7.7	7.8	7.8	7.6	7.7	7.7	8.0	7.6	7.6	7.8	7.4	7.7	7.7	7.6
			Inc.	8.0	8.0	7.7	7.8	7.8	7.6	7.7	7.7	8.0	7.6	7.6	7.8	7.3			
			I.B.	8.0	8.0	7.7	7.8	1.8	7.6	7.7	7.3	8.0	7.6	7.6	7.8	7.4	7.7	7.7	7.6

* R. = room temperature. Inc. = incubator, 37 C. I.B. = icebox.

One experiment was continued for 7 days, two for 10 days and one for 13 days. Table 1 gives the results obtained in one test. It shows how the reaction varied, altho when compared with results obtained in the other tests there was nothing consistent about these changes. Table 2 gives the limits of change under various conditions and is taken from all the experiments.

Most bacteria will grow over a very wide range. When grown in mediums they bring about changes in reaction until a final end point is reached. This end point seems to be pretty definite for certain types of organisms and has been used as a means of identification. Clark[2] discusses the diagnostic value of the final H-ion concentration in differentiating cultures of B. coli. Ayers,[3] Ayers, Johnson and Davis,[4] and Avery and Cullen[5] have all contributed to our knowledge of the end point reached by different varieties of streptococci.

TABLE 2

LIMITS OF CHANGE UNDER VARIOUS CONDITIONS FROM ALL EXPERIMENTS

Initial reaction given medium	PH6.4	PH6.8	PH7.2	PH7.6	PH8.0
Limits of variation produced by autoclaving	6.3-6.9	6.6-7.2	6.9-7.4	7.2-7.8	7.4-8.0
Limits of variation in tubes at room temp	6.4-6.8	6.5-7.2	6.3-7.2	7.1-7.9	7.6-8.0
Limits of variation in tubes in incubator	6.4-6.7	6.6-6.8	6.3-7.2	7.2-7.6	7.4-8.0
Limits of variation in tubes in icebox	6.4-6.7	6.6-7.2	6.3-7.2	7.1-7.6	7.3-8.0
Limits of variation in flasks at room temp	6.3-6.3	6.6-7.2	7.0-7.2	7.0-7.6	7.4-8.0
Limits of variation in flasks in incubator	6.3-6.6	6.6-6.9	6.5-7.2	6.6-7.6	7.3-8.0
Limits of variation in flasks in icebox	6.3-6.6	6.6-6.9	6.9-7.4	7.3-7.6	7.4-8.0

As a final test, a batch of plain broth was treated in the same way with the results shown in Table 3. While there was some variation in the reaction it will be noted that it is not nearly so great as was observed in the glucose broth. Presumably, therefore, the resulting acid formed by the breaking up of the glucose is the chief factor responsible for these changes. Amino acids formed from the peptone may also be a contributing factor.

We checked our work carefully in order that the charge of faulty technic would not be made to account for these variations. Every care was used in the preparation of the medium. The flasks and tubes were cleaned before using by boiling in soap suds, rinsing in ammonia water, then in tap water and finally in distilled water. In order to assure the constancy of the values of the colorimetric standards, checks were made by the electrometric method. These checks showed an error not exceeding 0.06.

It is probable, of course, that these changes have always occurred in mediums without our being aware of the fact.

As to just how important the initial reaction given culture mediums is, we are only beginning to find out, and it is quite probable that much work will have to be done before an optimum can be definitely established for each known organism or group of organisms.

As the latter question assumes greater significance, so will it grow to be more important to have a definite knowledge of the reaction of the medium just before it is inoculated. The variations that occur independent of the activities of bacteria must also be taken into account when making such studies.

It is possible that the simple method of adding normal acid or alkali solutions to mediums to give them the required degree of acidity or alkalinity may have to undergo some modifications.

[2] Jour. Biol. Chem., 1915, 22, p. 87.
[3] Jour. Bacteriol., 1916, 1, p. 84.
[4] Jour. Infect. Dis., 1918, 23, p. 290.
[5] Jour. Exper. Med., 1919, 29, p. 215.

TABLE 3

RESULTS OF FINAL TEST WITH PLAIN BROTH

Plain Broth			Medium Stored in Tubes						Medium Stored in Flasks				
Initial Reaction Given Medium	Reaction after First Autoclaving	Reaction after Final Autoclaving	*	Reaction after Standing Two Days	Third Day	Fifth Day	Sixth Day	Seventh Day	Second Day	Third Day	Fifth Day	Sixth Day	Seventh Day
PH 6.4	PH 6.4	PH 6.4	R.	PH 6.6	PH 6.4	PH 6.4	PH 6.4	PH 6.4	PH 6.5	PH 6.4	PH 6.4	PH 6.4	PH 6.4
			Inc.		6.4	6.4	6.4	6.4		6.4	6.4	6.4	6.4
			I.B.	6.6	6.4	6.4	6.4	6.4	6.5	6.4	6.4	6.4	6.4
6.8	6.9	7.2	R.	7.2	7.1	7.2	7.4	7.3	7.2	7.4	7.2	7.1	7.2
			Inc.		7.1	7.2	7.2	7.2		7.4	7.2	7.1	7.2
			I.B.	7.4	7.1	7.2	7.4	7.3	7.2	7.4	7.2	7.1	7.2
7.2	7.5	7.5	R.	7.5	7.4	7.5	7.5	7.5	7.5	7.5	7.4	7.4	7.4
			Inc.		7.4	7.5	7.5	7.5		7.5	7.4	7.4	7.4
			I.B.	7.5	7.4	7.5	7.5	7.5	7.5	7.5	7.4	7.4	7.4
7.6	7.6	8.0	R.	8.0	7.9	7.8	7.6	7.8	7.9	7.8	7.8	7.6	7.7
			Inc.		7.9	7.8	7.6	7.8		7.8	7.8	7.6	7.7
			I.B.	8.0	7.9	7.8	7.8	7.8	7.9	7.8	7.8	7.9	7.7
8.0	8.0	8.0	R.	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
			Inc.		8.0	8.0	8.0	8.0		8.0	8.0	8.0	8.0
			I.B.	8.0	8.0	8.0	7.8	8.0	8.0	8.0	8.0	8.0	8.0

* R. = room temperature. Inc. = incubator, 37 C. I.B. = icebox.

DRS. IRONS AND NOYES REAFFIRM THEIR STATEMENTS THAT A PULPLESS TOOTH IS NOT A DEAD TOOTH

To THE EDITOR:

In view of the well-deserved reputation for accuracy of *The Journal* it is surprising to note in the leading article of the issue of March, "Chronic Systemic Infections and Their Sources," by Ernest E. Irons, M. D., a statement absolutely inaccurate. This is all the more surprising because the paper in general is so well balanced, well considered, and of undoubted value and accuracy in every other respect.

I refer to the paragraph wherein, after expressing his hesitancy in referring to "so purely dental a question as that of the dead tooth" and announcing that "most physicians and possibly a few dentists conceive that a pulpless tooth is a 'dead tooth,'" Dr. Irons makes the following astounding statement absolutely in error: "Since the nutrition of a pulpless tooth may still be maintained by the intact peridental membrane, and its lymphatics may still be in vital connection with the lymphatics of the alveolar process, the use of the term 'dead tooth' in this connection is inaccurate and misleading. Terminology here may be profitably improved; but the essential fact to be insisted on is that the loss of the sensory function of the pulp thru its death does not fatally impair nutrition of the tooth."

I will not dispute with Dr. Irons the necessity of proper terminology but I do deny, and that most emphatically, that the death of the pulp does not fatally impair the nutrition of the tooth. And in support of this will quote from one of the very authorities Dr. Irons cites, viz., F. B. Noyes, *Dental Histology and Embryology*, who says: "The vital function of the pulp is the formation of dentin and is performed by the layer of odontoblasts. These cells also by means of their dentinal fibrils maintain the same relation to the dentin matrix that the bone and the cement corpuscles bear to the matrix of the bone and cementum. *When the pulp is removed from a tooth its dentin becomes dead dentin in the same sense that bone, in which the bone corpuscles have been killed, is necrosed bone*" (italics mine).

I know of no histologist who is not in perfect accord with this fact. The confusion in Dr. Irons' mind and his inaccuracy of statement arise from the fact that while it is true that if the pericementum (analogue of periosteum) remains intact and uninfected, the cementum of the tooth may maintain its viability for a time but this cementum is merely an inert, structureless, non-vascular substance of value solely as a sort of cartilaginous shock-absorber and to afford attachment for the pericemental fibers which hold the tooth in the alveolus. Not one drop of blood nor the slightest innervation passes beyond the cementum into the dentin or tooth proper. Moreover the cementum is exceedingly thin being about one to two hundred microns—say 1/100 of an inch—thick. Therefore comparing the minute bulk of this microscopical envelope with the overwhelming preponderance of the rest of a tooth which has lost its innervation and its blood supply and can be nothing else but dead, does it not seem like "straining at a gnat and swallowing a camel" to insist that a pulpless tooth is not a "dead" tooth. Finally the point to be insisted on is that even if the cementum may remain vital for a time, there is at present no method at the command of the dentist whereby he can effectively and permanently sterilize dead dentin or seal the foramina of a pulpless tooth against afferent or efferent bacteria or toxines.

The ultimate safeguard against the possibility of harm from a dead tooth to the host thereof resolves itself into a question of the personal reaction of the individual or his immunity and, in the presence of sufficiently grave general symptoms, the causes of which cannot be definitely determined, suspicion should lie against the dead tooth, or as Dr. Irons prefers, "pulpless" tooth and it would seem good judgment to direct its surgical removal. *(Signed)* ROBERT BURNS, JR.

April 4th, 1921.

TO THE EDITOR:

I have gone over the questions raised in the letter of Dr. Burns' forwarded by you to me for comment. I also enclose a letter from Dr. F. B. Noyes, to whom I submitted the questions raised by Dr. Burns.

The question raised by Dr. Burns as to the actual condition of a tooth whose pulp is dead

involves, first, considerations of dental histology and physiology which must be decided upon known facts so far as these have been ascertained, and, second, what actually happens to pulpless teeth when they are not interfered with, and therefore what treatment a patient should receive in the circumstances, in order that his best interests may be served. The question therefore has certain medical aspects, with which the physician is bound to concern himself.

I appreciate the kindly comment of Dr. Burns on the remainder of the article, and in the matter of the section to which he takes exception, I may say that, as I was careful to state, I have availed myself of the best dental counsel in formulating the statements made. While I do not care, nor am I qualified, to enter into a controversy on a purely dental question, I cannot pass by the partial quotation taken from Noyes' *Dental Histology*. Dr. Burns disputes the statement made by me that the death of the pulp does not fatally impair the nutrition of the tooth and quotes from Dr. Noyes' *Dental Histology and Embryology* as follows: "When the pulp is removed from a tooth its dentin becomes dead dentin in the same sense that bone in which the bone corpuscles have been killed is necrossed bone." Dr. Burns then continues: "While it is true that if the pericementum (analogue of periosteum) remains intact and uninfected the cementum of the tooth may maintain its viability for a time, but its cementum is merely an inert, structureless, non-vascular substance of value solely as a sort of cartilaginous shock-absorber and to afford attachment for the pericemental fibers which hold the tooth in the alveolus." The inference to be drawn from the quotation from Noyes is altered by removing it from its context. The concluding sentence of this paragraph reads as follows: "That the tooth remains functional after the loss of the pulp is due to the fact that except at the minute foramina, the dentin is not in physiologic contact with any tissue excepting enamel and cementum, and that the cementum attaches the tooth to the surrounding tissues receiving its nourishment from the surface and not from the dentin."

The inclusion of this latter portion of Dr. Noyes' statement would have enabled Dr. Burns to avoid the error of regarding the cementum only as a shock-absorber. Even admitting for argument that the cementum is structureless, its very thinness emphasized by Dr. Burns, makes possible the absorption and passage thru it of nutritive substances.

I have submitted Dr. Burns' criticism to Dr. Noyes, who writes as follows: "The quotation from my book is entirely changed in its meaning by being removed from the paragraph in which it occurs, and which you have correctly interpreted: 'To state that the cementum is merely an inert structureless, non-vascular substance of value solely as a sort of cartilaginous shock-absorber' is simply absurd."

I have further consulted with Dr. Thomas L. Gilmer and Dr. Arthur Black, to whom I submitted the statements made in my article before its publication; it is their opinion that the views expressed represent current stable dental opinion.

Aside from the dental angle presented above the question of pulpless teeth is of considerable interest to the physician.

In former years many alveolar abscesses were unrecognized; and the infectious bacteria therein gave use to metastatic lesions, many of which were disabling. The recognition of the presence of these lesions and the development of methods for their eradication marks a great advance in medical and dental science. However, like every other newly recognized principle, the removal of teeth for supposed infection has been greatly overdone, and there are many persons whose teeth have been removed on insufficient grounds and without relief of their original disabilities.

Judging by analogy with other structures in the body, there appears to be no reason why a tooth, one of whose functions, sensation, has been lost should be regarded as a foreign body, as is the sequestrum of an osteomyelitis. The conditions of the two cases are not the same and hence to speak of a "dead tooth," a term which suggests dead bone of an osteomyelitis is likely to mislead those who are not well informed on questions of dental pathology and to lead them to remove teeth which are functionally intact, under the mistaken impression that they are thereby doing their patients a service. One must assume that such removal is dictated by sincere motives, tho the effort is misdirected; nevertheless the extensive mutilations of the gums of some of our patients who have undergone the "surgical removal" of their "dead" teeth sometimes make medical men wonder if the older methods of extraction have been improved upon.

I have no doubt that Dr. Burns will fully agree with the effort of physicians to serve the best interests of their patients by avoiding unnecessary mutilations.

Very truly yours,

(Signed) ERNEST E. IRONS

MY DEAR DR. IRONS:

Dr. Burns and others in his group have greatly misinterpreted the statements of several authorities. The quotation from my book is entirely changed in its meaning by being re-

moved from the paragraph in which it occurs, and which you have correctly interpreted. The statements of Hopewell-Smith in regard to the presence of lacunae in normal cementum I think have also been misrepresented. The views in regard to the structure and nature of the cementum expressed by Dr. Burns are not only crude and inaccurate, but absolutely not in accordance with the facts. To state that "cementum is merely an inert, structureless, non-vascular substance of value solely as a sort of cartilaginous shock-absorber" is simply absurd. It is untrue on every count, if all areas of the roots of human teeth alone are included.

It seems to me useless to reply to the statements further, for I do not see how they could be made by one who had honestly made even a superficial study of the tissues and their development.

Very sincerely yours,

(Signed) FREDERICK B. NOYES

TRANSITION PHENOMENA IN AMALGAMS[1]—A DISCUSSION

Wilmer Souder and Chauncey Peters, Washington, D. C. (written discussion).—The paper deals in part with the actions taking place at temperatures between 70° and 85°C. and further confirms the probable universality of the abnormal behavior of amalgams at such temperatures; but it is not likely that any amalgam filling *in situ* will receive this extreme temperature treatment.

Dr. Gray has implied that hand-packed specimens are less uniform than mechanically packed specimens, and calls attention to our variation of 12.7 per cent in expansivity for a certain alloy *C*.[2] The larger part of this variation may well be due to a lack of uniformity of manufacturers' product since, as stated in the paper, different bottles of alloy were used for these tests. That machine-packed specimens are not homogeneous, under reasonable conditions, is shown by the 14 per cent variation of two points on the curve of crushing strengths reported to this society two years ago by Dr. Gray.[3] (In the absence of any statement to the contrary, it is assumed that all tests are for the same alloy.) Figure 18[4] represents crushes from a machine-packed amalgam under conditions that could possibly be reproduced in the mouth. The agreement improves somewhat in Figure 19[5] where the mechanical packing pressure is far above mouth possibilities; at eight to ten times the possible mouth pressures, Figure 20,[6] the uniformity is very much better.

This indicates that specimens packed in steel tubes with a close fitting piston forced down with a single thrust have non-uniform spots, mercury pockets, voids, etc., unless the pressure used is approximately ten times that possible for use in the mouth.

When Dr. Gray's values for expansion are corrected by the amount indicated, they run slightly higher than ours, with perhaps a tendency to higher values for the lower mechanical packing pressures; this may be due to an over correction for the inaccuracy of his dilatometer or to the presence of mercury pockets in the specimens, mercury being an element of large expansivity. The company with which Dr. Gray is associated has spent three years' research in developing a set of hand-packing instruments and a technic[7] which it claims eliminates voids in the amalgams and assures a homogeneous filling. Definite instructions

[1]Paper by A. W. Gray presented at the Columbus meeting, October, 1920, and issued with *Mining and Metallurgy*, No. 165, September, 1920, and reprinted in *The Jour. Nat. Dental Assoc.*, March, 1921, p. 196. This discussion is reprinted from *Pamphlet No. 1038*, American Institute of Mining and Metallurgical Engineers, with author's reply.

[2]"Transition Phenomena in Amalgams," p. 10.

[3]"Metallographic Phenomena Observed in Amalgams," *Trans. Amer. Inst. of Mining and Metallurgical Engineers*, LX (1919), 657-97.

[4]*Ibid.*, Fig. 7.

[5]*Ibid.*, Fig. 8.

[6]*Ibid.*, Fig. 9.

[7]L. D. Caulk, *Dental Quarterly*, February, 1919, p. 20.

usually accompany each ounce of alloy; some companies specify a special set of instruments and frequently employ men to demonstrate the proper manipulation of their alloys, to secure the best results. We have secured many valuable suggestions from these representatives. In our work we attempted to comply explicitly with each reasonable detail. In the article quoted,[8] we say: "The greatest variation in results, when using a given manipulation, appears to arise not so much from slight irregularities in manipulation of alloy as from variation in alloy from package to package. Another method of securing uniformity of results resorted to by some investigators consists in packing specimens under continued mechanical pressure, allowing several minutes to elapse before removing them from the matrix. The authors have been more interested in finding what happens to amalgams as they are ordinarily used or should be used."

Perhaps the impression has been left that our work on zinc content of amalgams is not definite. Those familiar with the amalgam problems know that practically all discussions on the effect of zinc have hinged on the question of the electromotive forces of zinc and non-zinc amalgams. In the light of this we include the table of values that summarizes the work on electromotive forces. From this table we may conclude that no effect need be expected due to differences of electromotive force between zinc and non-zinc alloys. The question of what takes place between gold and amalgam is far more important.

As to the effect of zinc on the transformation or critical region, we cannot attach nearly the importance given it by Dr. Gray. The

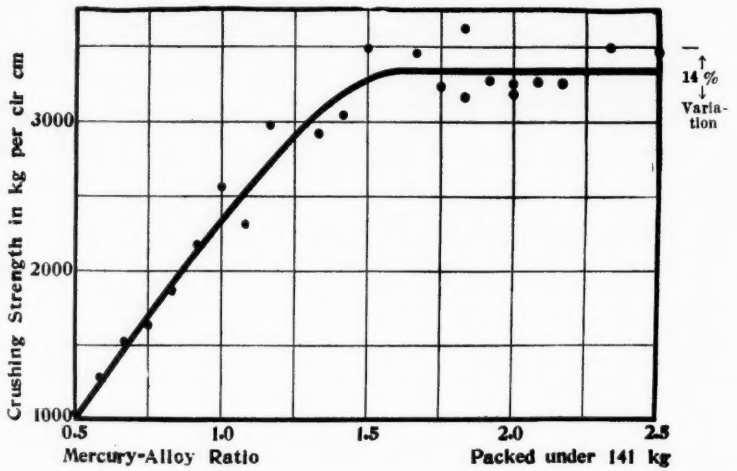

Fig. 18—Effects of varying relative amounts of mercury and alloy that are mixed together in making an amalgam.

TABLE 3.—Electromotive Force of Zinc Alloys

Alloy	E.m.f.	Alloy	E.m.f.
0 per cent zinc	—0.54	1 per cent zinc	—0.52
0 per cent zinc (duplicate)	—0.55	2 per cent zinc	—0.52
0 per cent zinc, 16 per cent copper	—0.52	5 per cent zinc	—0.51
0 per cent zinc, 16 per cent copper (duplicate)	—0.52	Gold (metallic)	+0.002

[8]W. H. Souder and C. G. Peters, "Investigation of the Physical Properties of Dental Materials," *Dental Cosmos*, LXII (1920).

fact that alloys of zinc and non-zinc "sweat" droplets at or near the critical region makes us cautious in generalizing the indicated expansivities above 60° C. These droplets sometimes crystallize, as shown by his photographs. These crystals may contain as much as 75 per cent tin, the remainder being mercury. When one of these droplets exudes beneath a lever of the expansivity apparatus it causes this lever to indicate false, thermal expansion. As this liquid crystallizes, which it will do at falling temperatures, it separates farther the parts of the apparatus and indicates an expansion of local crystals whereas the major part of the specimen may be undergoing real contraction. Figures 10, 11, and 12 are easily explained by this fact.

We have watched these drops exude beneath the contact of the interferometer. When they form at points other than those of contact, the amalgam may pass thru this region with only a slight jog in the curve. Our experiments showed that it was not likely that any amalgam filling would be subjected to this high temperature; the hottest temperatures recorded in amalgams in the mouth are below this. Hence, little attention is being given to this phase of the investigation, as it does not appear to be of vital importance in dental fields.

Arthur W. Gray (author's reply to discussion).—Messrs. Souder and Peters' attempt to show that specimens of dental amalgams condensed in a mold by a measured pressure applied thru a piston are no more uniform, under what they term reasonable conditions, than specimens packed by hand pressure with the instruments used by dentists in filling teeth. They cite two points plotted on a chart[9] published to show how the crushing strength of an amalgam is affected by varying the relative amounts of mercury and alloy that are mixed together. These points represent two cylinders that failed under crushing loads of 3627 kg. and 3167 kg., respectively. The difference between these extreme values is about 13.5 per cent of their average.

They apparently failed to note that all the charts preceding Figure 12 in the paper cited represent the results of preliminary tests, in which the specimens were crushed at room temperature, and both the compression and the balancing of the crushing load were regulated by hand. One of the two cylinders was made five days before the other from a different batch of alloy. Both were crushed twenty-four hours after making, or before the amalgam had completely hardened. Thus, the deviation ascribed to lack of homogeneity in machine-packed amalgams may well have been due to variation in any one or more of several unknown factors, including those occasional irregularities that seem inseparable from strength tests.

If reference be made to Figures 12 and 15

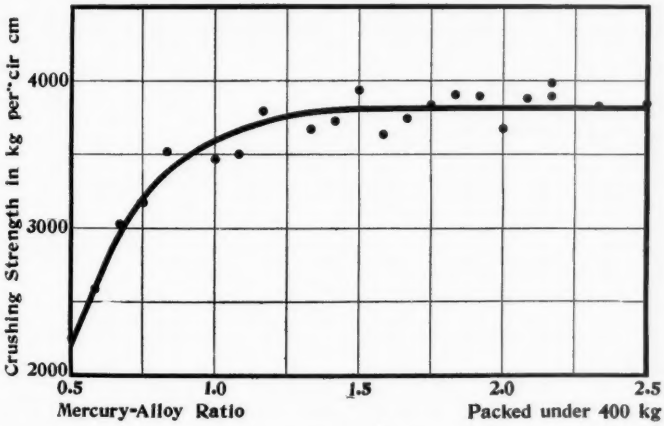

Fig. 19—Modification of Fig. 18 produced by increasing packing pressure from 141 to 400 kg. per cir. cm.

[9]A. W. Gray, "Metallographic Phenomena Observed in Amalgams," *Trans.*, LX (1919), p. 666., *Jour. Nat. Dental Assoc.*, VI (1919), p. 520.

to 20 of the same paper, no such deviations will be found, altho all the points in the charts represent individual specimens and no results in any series have been suppressed, even when they deviated more than usual from the averages. On the other hand, in the charts representing the preliminary tests, without temperature control and without regularity in load application, numerous examples can be found of even greater deviations than the one cited. The results of some preliminary tests were published because, in spite of their large deviations, they appeared to give sufficient evidence in regard to the phenomena that they were designed to elucidate.

packing pressures. These defects can easily be seen with a low-power microscope and often with the naked eye. To a large extent they can be obliterated by suitable manipulation of the amalgam during packing with dental instruments; but their frequent occurrence even in hand-packed amalgams can easily be verified by the examination of fillings in extracted teeth.

The various dental alloys on the market differ widely in regard to the ease with which such defects in fillings can be avoided. These differences are readily detected by observing under moderate magnification the surfaces of amalgams packed

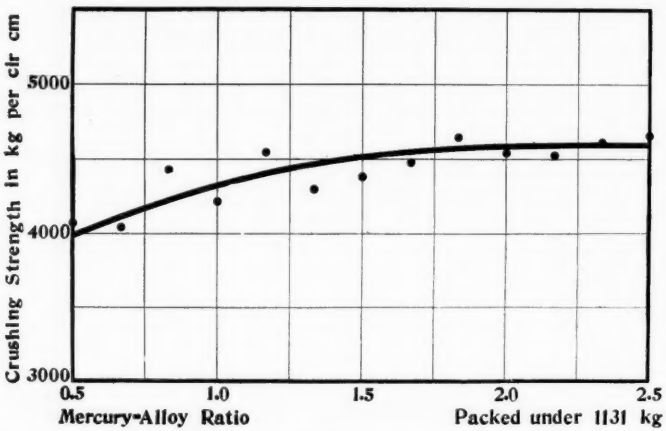

Fig. 20—Modification of Figs. 18 and 19 by further increase of packing pressure to 1131 kg. per cir. cm.

As Messrs. Souder and Peters point out, the deviations of the plotted points from the curves in the three charts that they reproduce decrease with increase of packing pressure. An improvement of this kind is to be expected. But that it may not all be due to increase of packing pressure is suggested by some of the large deviations at still higher pressures plotted in Figure 6 of the same paper. Moreover, 400 kg. per cir. cm. is not far above mouth possibilities and 1131 kg. per cir. cm. is not eight to ten times the possible mouth pressure, as Messrs. Souder and Peters assert. It is true that a pressure of 400 kg. per cir. cm., which is equivalent to 4 kg. per cir. mm., is not usual in filling a tooth; but it is possible in small cavities favorably located.

Specimens of dental amalgams packed by piston pressure do show non-uniform spots, mercury pockets, voids, etc., especially at low

by piston with the same fairly low pressure, such as 25 or 50 kg. per cir. cm. They are most clearly revealed when sufficient time has elapsed after packing for the free mercury on the surfaces to diffuse into the interiors. Structural defects that interfere with proper adaptation of the amalgam to the walls of the tooth cavity are quite as serious as the shrinkage and flow of amalgams from low-silver alloys. A proper testing procedure will accentuate rather than conceal imperfections in a material under examination.

The packing instruments to which Messrs. Souder and Peters refer were designed to assist dentists in filling teeth. They were not designed to prepare specimens for physical tests intended to compare different dental alloys.

The condensation of amalgam test specimens by hand pressure or mallet blows is

fundamentally wrong if the object be to make a reasonably accurate comparison of different dental amalgam alloys. Messrs. Souder and Peters appear to have confused testing for this purpose with testing to learn the behavior of different amalgams when employed for filling teeth. No testing method can be regarded as satisfactory until it is capable of such definite specification that different investigators will obtain essentially the same results when attempting to test the same material in accordance with the specified procedure. Dental amalgams are so sensitive to manipulation during packing that different observers get widely divergent results from hand packing the same alloy even when following the same directions. Machine packing under measured pressure *is* capable of definite specification, and yields results reproducible with fair uniformity, even as regards non-uniform spots, mercury pockets, voids, etc. Hand pressure, mallet blows, burnishing, tamping, and other dental manipulations that depend on the judgment and skill of the operator *are not* capable of definite specification.

Although mechanical packing under high pressure can be used to produce amalgam specimens considerably stronger than those produced by dental methods of packing, it is not necessary to force up the strength in this way. Test specimens can also be prepared under packing pressures that will yield amalgam of which the strength and other characteristics will be essentially the same as obtained when dental methods are used.

Because the knowledge of such packing pressures is of great importance in furnishing a connecting link between the methods of manipulation necessary in dental practice and the methods of manipulation suitable for comparative tests of dental alloys, I have determined the mean effective dental packing pressures employed by different individuals in condensing amalgam. These range from less than 20 to more than 200 kg. per cir. cm. in packing cylindrical cavities only 3 mm. in diameter. Even in the case of a dentist possessing unusual skill in making amalgam restorations, the mean effective pressure ranged from 62 to 234 kg. Larger cavities, such as those used by Messrs. Souder and Peters, while easier to pack mechanically, are still more difficult to pack by hand.

Messrs. Souder and Peters do not indicate how they determined "possible mouth pressures." The mean effective dental packing pressure cannot be computed from measurements of the operator's hand thrust and the area of the packing instrument used. Since it depends on several other factors, including the size of the cavity and the nature of the amalgam, it must be determined experimentally. For this purpose, use may be made of variations in any property that can be expressed as a known function of the packing pressure, such as strength, mercury content, density, or reaction expansion.

In the cases cited, the mean effective pressure was determined by application of the logarithmic law connecting crushing strength with packing pressure.[10] The specimens were all crushed when within one degree of 37.5° C. and corrections were applied for any deviations from this temperature. For determining the constants in the equation, a pair of test cylinders were packed under each of the following pressures: 100, 200, 400, 800, and 1600 kg. per cir. cm. The crushing strength found for each cylinder differed from the average for the pair by 1.1, 0.2, 2.6, 2.0, and 1.3 per cent, respectively, the average being 1.4 per cent.

Thirteen specimens of the same amalgam were packed by hand in the same mold with dental instruments; each of four individuals, using the same instruments, packed from one to five specimens as well as he could. The average deviation from the average crushing strength was 7.6 per cent of this average; the difference between the highest and the lowest value was 34 per cent. The average value of the mean effective packing pressure was 68 kg. per cir. cm.; the average deviation from this was 64 per cent; the difference between the highest (234 kg.) and the lowest (17 kg.) was 321 per cent. Do these results indicate that hand-packed specimens are more reliable than machine-packed ones for the purpose of comparing different dental amalgam alloys?

In trying to account for their variation of 12.7 per cent in the thermal expansivity of a certain alloy, Messrs. Souder and Peters assert that "the larger part of this variation may well be due to a lack of uniformity of manufacturers' product since, as stated in the paper, different bottles of alloy were used for these tests;" and again, that "the greatest variation in results, when using a given manipulation, appears to arise not so much from slight irregularities in manipulation of alloy as from variations in alloy from package to package." This explanation is plausible, but it is not valid. They submit no data to show that their experimental technic is sufficiently reliable to yield substantially the same result when ever a given test is repeated with samples of alloy from the same package. They have failed to control either packing pressure of temperature, both of which exert considerable influence upon

[10] *Trans.*, p. 664; *Jour. Nat. Dental Assoc.*, p. 518.

the behavior of a dental amalgam.[11] At body temperature, a change of 1° C. changes the crushing strength approximately 50 kg. per cir. cm., or 900 lb. per sq. in. If neither temperature nor packing pressure is controlled, what significance can be attached to variations of a few thousand pounds per square inch in the results of crushing tests? Messrs. Souder and Peters have published results to 50 lb. per sq. in., notwithstanding such fluctuations due to temperature alone.[12]

As a matter of fact, numerous tests of dental alloys fail to show any such lack of uniformity as Messrs. Souder and Peters assume. Some alloys are, indeed, defective, especially as regards annealing. Some manufacturers, recognizing that their products change with age, date the packages and inform the dentist that alloy more than a year old should be exchanged for fresh material.

The correction that Messrs. Souder and Peters have ascribed to the inaccuracy of my dilatometer is a correction of exactly the same nature as the one they apply to their own measurements because of the expansion of the base of their interferometer, and which they designate by *Cs* in equation (4).[13] Since my reference material was invar instead of glass, my correction was only about one-tenth (or perhaps only about one-twentieth) of the correction necessary with the interferometer. For my purposes a closer knowledge of the expansivity did not warrant the labor involved in a special determination.

The claims that have been made in regard to the effect of zinc on a dental amalgam have by no means been confined to its alleged effect on electromotive force. This particular claim is of recent origin, and has been exploited mainly, if not solely, in connection with advertising propaganda. Measurements made by the writer early in 1917 showed that zinc produced but little effect on the electromotive force developed between gold and amalgam, either in the mouth or in various electrolytes. The results published by Messrs. Souder and Peters confirm these observations.

Messrs. Souder and Peters do not make clear how Figures 10 and 11 are easily explained by an expansion of local crystals during their formation at falling temperatures, since both of these figures show the abnormal expansion at constant or slowly rising temperatures.

They certainly would not insist that the phenomena I have recorded are of no importance in dental fields. Failure to show immediate practical applications does not necessarily mean that the information disclosed may not lead to new developments, or that it is without interest to metallographists.

[11] *Ibid.*

[12] Table 3, entitled "Comparison of Amalgams," *Dental Cosmos,* LXII (1920), pp. 332-334; Bureau of Standards, *Technical Paper, No. 157* (1920), p. 38.

[13] *Dental Cosmos,* LXII (1920), p. 312; Bureau of Standards, *Technical Paper No. 157,* p. 13.

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VOL. 8 JUNE, 1921 NO. 6

Editorial Department

ONLY THE MOST RIGID ECONOMY WILL PREVENT INCREASE IN DUES

The high cost of living has hit the American Medical Association a solar plexus blow. At a specially called meeting of the House of Delegates the American Medical Association dues were increased to $6 per year, the new arrangement to be effective January, 1921. In commenting on the necessity for securing an increased income the Board of Trustees made a statement which showed that all expenses of the Asso-

ciation had been enormously increased in consequence of the increased cost of labor and material, and that while there had been some increase in the income it was not sufficient to cover the inevitable deficit that would occur with present prices. Concerning the cost of the *Journal of the American Medical Association* it was stated that today the paper is costing 154 per cent more than in the year 1914, and labor in the mechanical departments has increased approximately 139 per cent in the same time. They also stated that labor in clerical departments has increased about 100 per cent.

As might be expected, some opposition was made to the proposed changes at a time when prices seemed to be falling. The answer is that both labor and materials will have to come down a great deal before the *Journal* can be published at its present price without a great loss. As a matter of fact, labor in the printing trades, controlled by the strongest labor organizations, will not come down for many months, as already most of the printing houses have wage contracts running well on to two years, and even when the price of labor does drop it is not likely that it will ever go back to where it was even a few months ago. Furthermore, the outlook as to a drop in the price of paper is not at all encouraging, as the mills have orders which will keep them busy for many months to come, and even then there is little prospect that there will be any great reduction in price.

Concerning the increase in the cost of labor the average reader may not know that even during the last two years compositors, press feeders and pressmen have received steadily increasing wages from an average of $27.50 per week up to $50.00 per week at the present time. Bindery workers, machinists, cutters, and workers of every type have had proportionate increases. The astonishing feature is that the Board of Trustees of the American Medical Association has asked for but a 20 per cent increase in the dues, when admitting that they think another increase may be required at the Boston meeting, to go into effect in 1922.

What has occurred in connection with the publication of the *Journal of the American Medical Association* has occurred in the publication of newspapers and periodicals of every type. Increased subscriptions and increased advertising rates have been imperative in order to prevent bankruptcy. The National Dental Association is fortunate in having a balance on hand so that at the present time it is possible to meet the increased demands without further increase in the dues.

The Journal, like all other publications, has had to face the high cost conditions, and the National Dental Association will also be threat-

ened with a large deficit unless all officers and the House of Delegates conserve our funds. The keenest and shrewdest business sagacity must be manifested in protecting our treasury against the appropriation of large sums to other subsidary organizations or committees.

MEDICAL USE OF WHISKY

Things are not always what they seem, says the poet. And in the world of practical affairs, general statements, even oft repeated and popularly accepted, do not always check up with the facts. Much has been made of the claim that the adoption of federal prohibition has seriously interfered with the use of whisky for medicinal purposes by physicians. The Anti-Saloon League of Delaware, in a recently issued circular, presents an interesting table on this question, based on information furnished by federal and state officials and statistics taken from the American Medical Directory. According to this tabulation, there were at the time the federal prohibition amendment was adopted, twenty-four states—one-half the entire number—whose laws forbade either the writing or the filling of prescriptions for whisky or brandy. In these states, naturally, no permit under the federal law could be issued to physicians. In the remaining twenty-four states, in which there is no such law and in which, under the Volstead Act, permits to prescribe whisky may be issued to physicians, there are according to American Medical Directory, 112,238 practicing physicians. Yet in these twenty-four states, only 33,379 physicians—29 per cent—have taken out permits. Evidently, the remaining 71 per cent do not regard whisky as of enough value in the practice of medicine to go to the trouble of taking out a permit.—*Journal of the American Medical Association*, February 19, 1921.

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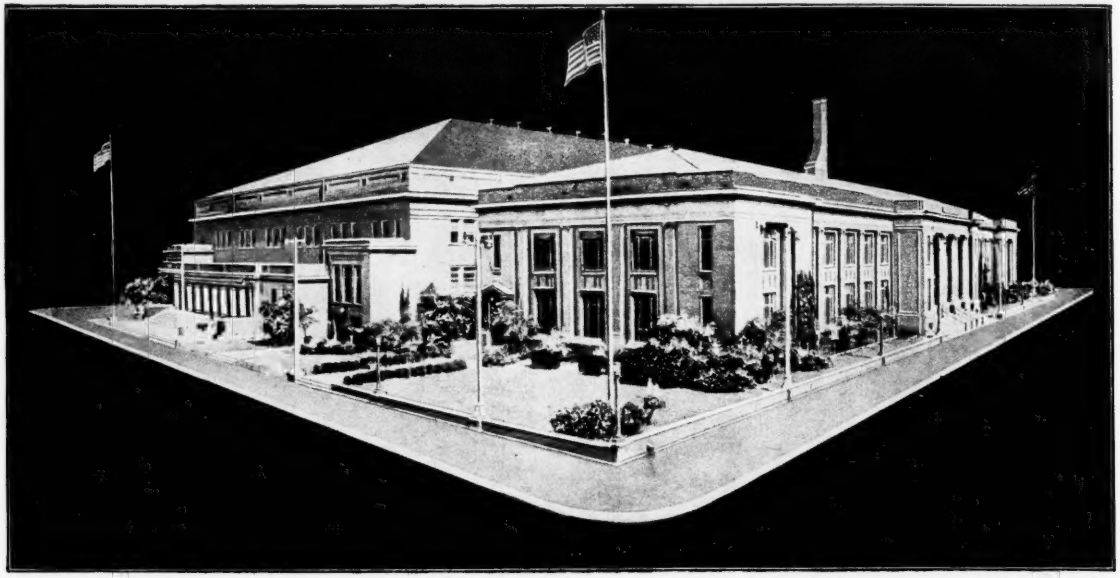

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Solomon Juneau	850	5,400
Byron W. Kilbourn	900	5,580
Peter Englemann	850	5,520
George H. Waker	300	2,574
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TUESDAY AFTERNOON, AUGUST 16

2:00 P. M. TO 4:00 P. M.

(Plankinton Hall, Auditorium)

This section will present seven papers and five unit clinics. Three papers will be read Wednesday morning and two Thursday morning and the clinics demonstrating them will follow in the afternoons of same days, under the direction of the essayists:

"Fundamentals of Cavity Preparation"
By R. R. Byrnes.....Atlanta, Ga.

"The Greatest Need in Dentistry, the Dental Care of Children"
By Thomas B. McCrum.....
.....Kansas City, Mo.

WEDNESDAY MORNING

9:00 A. M. TO 12:00 M.

(Plankinton Hall, Auditorium)

"An Amplified Technic Making Cohesive Gold a Comparative Pastime"
By Charles Southwell.....Milwaukee, Wis.

"Wax Patterns for Cast Gold Inlays"
By Roscoe H. Volland.....Iowa City, Iowa

"The Cast Inlay Restoration"
By George M. Hollenback.....
.....Los Angeles, Cal.

WEDNESDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

(Arena, Auditorium)

CLINICS:

"An Amplified Technic Making Cohesive Gold a Comparative Pastime"
By Charles Southwell and six assistants

University of Iowa Cast Gold Inlay Clinic:

1. "Cavity Preparation"
   By Roscoe H. Volland.....Iowa City, Iowa
2. "Investing Wax Pattern"
   By J. V. Blackman.....Iowa City, Iowa
3. "Dissipating Wax Pattern"
   By G. O. Nichols.....Iowa City, Iowa
4. "Casting Inlays"
   By Erling Thoen.....Iowa City, Iowa

"The Cast Inlay Restoration"
By George M. Hollenback.....
.....Los Angeles, Cal.

THURSDAY MORNING

9:00 A. M. TO 12:00 M.

(Plankinton Hall, Auditorium)

"Root-Canal Technic"
By J. F. Biddle.....Pittsburgh, Pa.

"Radiographic Studies of Cases Following Pulp Treatment and Chronic Alveolar Abscesses"
By Frank W. Hergert.....Seattle, Wash.

THURSDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

(Arena, Auditorium)

CLINICS:

"Root-Canal Technic"
By J. F. Biddle and assistants.....
.....Pittsburgh, Pa.

"Radiographic Studies of Cases Following Pulp Treatment and Chronic Alveolar Abscesses"
By Frank W. Hergert.....Seattle, Wash.

FULL DENTURE PROSTHESIS AND PARTIAL DENTURE PROSTHESIS

OFFICERS OF SECTION

Charles Lane, Chairman.....Detroit, Mich.
1526 Woodward Ave.

Fred W. Allen, Vice-Chairman....Boston, Mass.
520 Beacon St.

William H. Elliott, Secretary....Detroit, Mich.
1539 Jefferson Ave. E.

We are sorry to report that no definite program has been furnished for publication from this section.

ORAL SURGERY, EXODONTIA AND ANESTHESIA

OFFICERS OF SECTION

John W. Seybold, Chairman.....Denver, Colo.
304 Mack Bldg.

William L. Shearer, Vice-Chairman.....
.....Omaha, Neb.
City National Bank Bldg.

J. P. Henahan, Secretary.....Cleveland, Ohio
1019 Rose Bldg.

TUESDAY AFTERNOON, AUGUST 16

2:00 P. M. TO 4:00 P. M.

(Arena Stage, Auditorium)

"The Surgical Management of Serious Focal Infection Cases When Caution Is to Be Exercised and When Surgical Procedure Is Indicated"
By T. A. Hardgrove.....Fon du Lac, Wis.

"A New Method of Treating Harelip and Cleft Palate"
(The treatment of harelip and cleft palate describing a new method for the relief of lateral tension in operations for the surgical correction of a cleft of the hard and soft palate.)
By M. N. Federspiel.....Milwaukee, Wis.

WEDNESDAY MORNING

9:00 A. M. TO 12:00 M.

(Arena Stage, Auditorium)

"Differential Diagnosis and Treatment of Syphilis, Tuberculosis and Vincent's Angina"
By Edward H. Hatton.....Chicago, Ill.

"Principles of Surgery, Modern Methods" (lantern slides)
By Bernard F. McGrath..Milwaukee, Wis.

"Clinical and X-Ray Examination of Mouth, Jaws and Antra with a Diagnosis of Findings"
By Virgil Loeb.....St. Louis, Mo.

WEDNESDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

(Arena Stage, Auditorium)

"The Surgical Anatomy in the Field of Oral Surgery"
By D. M. Loughlin.....Milwaukee, Wis.

"Cleft Palate and Harelip"
By William H. G. Logan.....Chicago, Ill.

THURSDAY MORNING

9:00 A. M. TO 12:00 M.

Surgical clinics at hospitals

(There will be no surgical operations except by local surgeons who have hospital connections).

THURSDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

"Physical Examination and Management of Anesthetic Complications"
By F. A. Thompson.....Milwaukee, Wis.

"Conductive Anesthesia, Technic, and Management"
By C. W. Harned.....Des Moines, Iowa

FRIDAY MORNING

9:00 A. M. TO 12:00 M.

Surgical operations in hospitals

ORTHODONTIA AND PERIODONTIA

OFFICERS OF SECTION

Paul R. Stillman, Chairman....New York, N.Y.
52 Vanderbilt Ave.

W. C. Fisher, Vice-Chairman..New York, N.Y.
501 Fifth Ave.

John Oppie McCall, Secretary....Buffalo, N. Y.
360 Linwood Ave.

TUESDAY AFTERNOON, AUGUST 16

2:00 P. M. TO 4:00 P. M.

(Committee Room "A," Auditorium)

Address
By Paul R. Stillman.....New York, N. Y.

"Dento-Facial Deformities"
By B. E. Lischer.....St. Louis, Mo

"A Further Study in Compensatory Treatment for Missing Teeth"
By B. Frank Gray.....San Francisco, Cal.

"A General-Purpose Orthodontic Appliance"
By William J. Brady—Kansas City, Mo.

John Plankinton Hall, Auditorium, meeting place of the House of Delegates, of all General Sessions, and of the section on Operative Dentistry; especially adapted to this usage because of perfect acoustics. Prior to each of the General Sessions there will be an organ recital on the beautiful electrical pipe organ.

WEDNESDAY MORNING

9:00 A. M. TO 12:00 M.

(Committee Room "A," Auditorium)

"The Making of Diagnosis and Prognosis of Periodontic Lesions"
By Elmer S. Best.....Minneapolis, Minn.

"Some of the Essentials in the Treatment and Subsequent Care of the Investing Structures of the Teeth Beyond the Preventive Stage"
By Elbert J. Weaver.....Milwaukee, Wis.

"Altering Abnormal Surface Wear"
By F. A. Bricker.....Rochester, Minn.

WEDNESDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

(Committee Room "A," Auditorium)

"The Field of the Removable Appliance and the Blending of the Removable and Fixed Principles"
By Victor Hugo Jackson.....
.....New York, N. Y.

"Child Psychology in Orthodontia Practice"
By George F. Burke.....Detroit, Mich.

"Treatment of Some Extreme Cases of Mal-occlusion and Dento-Facial Deformities After the Developmental Period"
By A. C. Rohde.....Milwaukee, Wis.

THURSDAY MORNING

9:00 A. M. TO 12:00 M.

(Committee Room "A," Auditorium)

"The Surgical Treatment of Periodontal Lesions"
By Justin D. Towner.....Memphis, Tenn.

"Periodontal Response to Irritation"
By Newton G. Thomas.....Chicago, Ill.

"Traumatic Occlusion and Its Correction in the Treatment of Pyorrhea Alveolaris"
By Tom Smith.....Langdon, N. D.

MOUTH HYGIENE AND PREVENTIVE DENTISTRY

OFFICERS OF SECTION

E. L. Pettibone, Chairman.....Cleveland, Ohio
6503 Detroit Ave.
Justin D. Towner, Vice-Chairman.....
.....Memphis, Tenn.
1607 Central Bank Bldg.
C. H. Schott, Secretary.....Cincinnati, Ohio
1004 Neave Bldg.

TUESDAY AFTERNOON, AUGUST 16

2:00 P. M. TO 4:00 P. M.

(Juneau Hall, Auditorium)

Lecture for Normal School Students. Illustrated by charts
By G. D. Edgar.....Defiance, Ohio

Lecture Outlines Developed by the First and Second District Dental Societies of New York
By Thaddeus P. Hyatt....New York, N. Y.

"Industrial Dentistry"
By Henry L. Banzhaf.....Milwaukee, Wis.
(Dr. Banzhaf has an original idea of conducting an industrial dental dispensary.)

4:15 P. M.

Industrial Dental Surgeons' Meeting

This lecture will be followed by a meeting of the National Association of Industrial Dental Surgeons in this room. All interested in industrial dentistry are invited to be present.

WEDNESDAY MORNING

9:00 A. M. TO 12:00 M.

(Juneau Hall, Auditorium)

"Contour Brushing"
By Henry Barnes.....Cleveland, Ohio

"A Modern Method of Financing Mouth Hygiene Dispensaries"
By Harris R. C. Wilson....Cleveland, Ohio

"The McDowell County, West Virginia, Pre-School Dental Clinic and School Dental Clinic as Established and Maintained by the Tax Levy."
By G. T. Epling.....Welch, W. Va.

THURSDAY MORNING

9:00 A. M. TO 12:00 M

(Juneau Hall, Auditorium)

"Mouth Hygiene Lecture to School Children"
By Sidney J. Rauh.....Cincinnati, Ohio
(Dr. Rauh will demonstrate teaching of mouth hygiene)

"Mouth Hygiene Lecture for High-School Pupils and Adults" (illustrated by lantern slides)
By E. S. Braithwaite.....Willard, Ohio

"Preventive Initial Preparation of All Mouths"
By H. G. Morton.....Milwaukee, Wis.

General discussion of all papers

THURSDAY AFTERNOON AND FRIDAY

(Arena, Auditorium)

CLINICS:

"Contour Brushing"
By Henry Barnes.....Cleveland, Ohio

"The Cleveland Mouth Hygiene Dispensaries"
By Harris R. C. Wilson....Cleveland, Ohio

Ten clinics
By Wallace Seccombe and his associates.....Toronto, Canada

HISTOLOGY, PHYSIOLOGY, PATHOLOGY, BACTERIOLOGY AND CHEMISTRY (RESEARCH)

OFFICERS OF SECTION

Weston A. Price, Chairman.....Cleveland, Ohio
8926 Euclid Ave.
R. H. Volland, Vice-Chairman,.....
.....Iowa City, Iowa
Harris R. C. Wilson, Secretary.....
.....Cleveland, Ohio
701 Schofield Bldg.

TUESDAY AFTERNOON, AUGUST 16

2:00 P. M. TO 4:00 P. M.

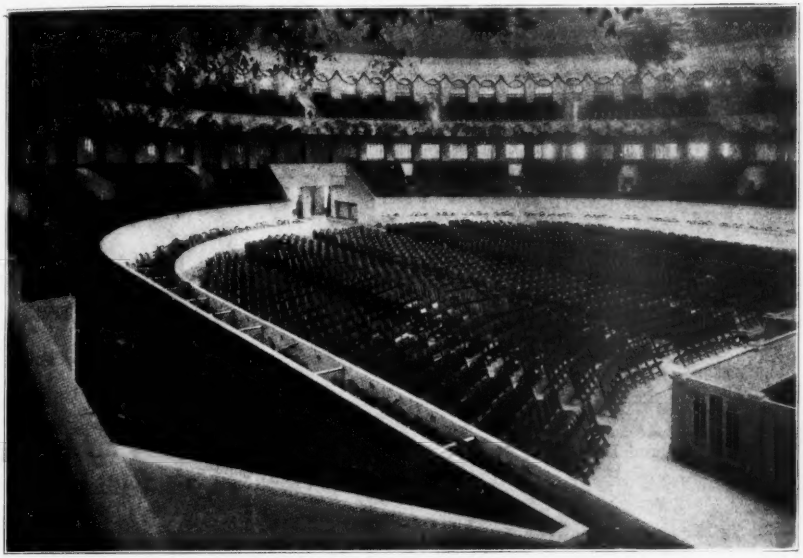
(Englemann Hall, Auditorium)

STRUCTURE AND DEVELOPMENT OF DENTAL TISSUES

"The Histology of Dentin and the Contents of the Tubuli"
By C. B. Bodecker.....Berlin

(A) "A Classification of Oral Manifestations of Systemic Disease According to Type"

(B) "A Report of the Laboratory Findings of Twenty-five Cases of Infantile Scurvy, or Barlow's Disease"
By Harry Block.....St. Louis, Mo.



Convention Hall, Auditorium, where Silver Anniversary Banquet will be held; the clinics will also be given here.

WEDNESDAY MORNING

9:00 A. M. TO 12:00 M.

(Englemann Hall, Auditorium)

LOCAL AND SYSTEMIC EXPRESSIONS OF DENTAL INFECTIONS

"Elective Localization of Bacteria Isolated from Infected Teeth"
By John G. Meisser and Boyd S. Gardner.....Rochester, Minn.

"Studies of the Vital Processes of Bacteria"
(A) Salt Antagonisms
(B) Surface Tension Influences
(C) Immunizing Properties of Bacteria Grown Under Different Conditions
By W. P. Larson and Thomas B. Hartzell.....Minneapolis, Minn.

"Etiology and Pathology of Glomerulo Nephritis"
By E. T. Bell and Thomas B. Hartzell.....Minneapolis, Minn

"Researches on Fundamentals Underlying Dental Diagnosis"
(A) Determinations of the Amount of Dental Infection Necessary to Produce Systemic Disturbance
(B) The Effect of Toxine Contained in Infected Teeth in Producing Sensitization of Special Body Tissues to Infections from Those Teeth
(C) Relationships Between Local and Systemic Expressions of Dental Infections
By Weston A. Price.....Cleveland, Ohio

WEDNESDAY AFTERNOON

2:00 P. M. TO 4:00 P. M.

(Englemann Hall, Auditorium)

DEMONSTRATION CLINIC:

(A) Exhibit of Specimens, Pictures, and Slides
By Boyd S. Gardner and John G. Meisser.....Rochester, Minn.

(B) Exhibit of Specimens, Pictures and Slides
By Thomas B. Hartzell, W. P. Larson, and E. T. Bell.....Minneapolis, Minn.

(C) Motion Pictures Showing Comparison of the Lesions in Patients and Those of Animals Inoculated with Cultures from the Patient's Dental Focal Infections, Also Showing Sensitization Effects.
By Weston A. Price.....Cleveland, Ohio

THURSDAY MORNING

9:00 A. M. TO 12:00 M.

(Englemann Hall, Auditorium)

STRUCTURAL CHANGES IN DENTAL TISSUES

Supporting Structures
"Further Studies of the Effect of Diet upon the Teeth and Jaws"
By Percy R. Howe.....Boston, Mass.

Enamel and Dentin
"Report of Research upon Saliva"
By John A. Marshall.....
.....San Francisco, Cal.

"The Etiology of Dental Caries"
By F. Bodecker.....Berlin

GENERAL AND UNIT CLINICS

Classified by States

(Arena, Auditorium)

OFFICERS

Adoph Gropper, Chairman....Milwaukee, Wis.

(All these clinics will be held in the Arena. There will be four half-days of clinics—Wednesday and Thursday afternoons and all day Friday. All section clinics, except the section on full Denture Prosthesis and Partial Denture Prosthesis will be held in the Arena with the General Session clinics.)

ALABAMA

Charles G. Dillard, Director.....Huntsville

"Dental Radiographs"
By Charles F. Chandler.....Montgomery

"Prophylaxis and Pyorrhea"
By Charles B. Fowlkes.....Birmingham

"Pyorrhea"
By H. C. Hassell.....Tuscaloosa

"Inlays"
By Charles G. Dillard.....Huntsville

"Fixed Bridge-Work on Vital Abutments"
By R. J. Monette.....Birmingham

"A Form of Fixed Sanitary Bridge on Vital Abutments"
By J. R. Rutland.....Montgomery

"Conductive Anesthesia"
By J. A. Blue.....Birmingham

"Removable Bridge-Work"
By J. B. Brothers.....Birmingham

"Artificial Dentures"
By A. K. Parks.....Montgomery

"Orthodontia"
By F. F. Perry.....Montgomery

"Pyorrhea"
By Olin Kirkland.....Montgomery

CALIFORNIA

Frank C. Pague, Director.....San Francisco

"Cast Partial Dentures"
By James Allen Graham.....San Francisco

"Porcelain Jacket Crown Technic"
By Hugh Avary.....San Francisco

"Compensatory Treatment for Missing Teeth"
By B. Frank Gray.....San Francisco

"Surgical Preparation of Mouths for Full Dentures."
By William A. Colburn.....San Francisco

GEORGIA

Harry B. Johnston, Director.....Atlanta
Root-Canal Section (Group)
Atlanta Clinic Club

ILLINOIS

Victor H. Fuqua, Director.....Chicago

"Combination of Vulcanite and Metal Full Dentures"
By W. H. Kubacki
Roscoe W. Upp.....Chicago

"Record System and Findings in Examination of 15,231 Employees at International Harvester Company Dental Department"
By Robert I. Humphrey.....Chicago

"Dentistry: A Phase of the Health Program for a Suburban Public School"
By Earl E. Graham.....Lake Forest

"Prophylaxis"
By Lester F. Clow.....Chicago

"Removable Dentures"
By Polk E. Akers.....Chicago

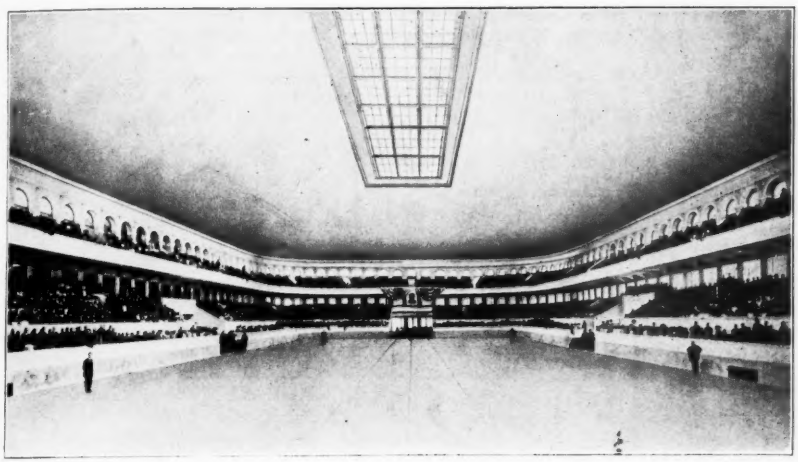
"Reducing the Possibility of Error in X-Ray Diagnosis"
By Charles U. Hillweg.....Chicago

"Large Gold Castings Using a Vulcanite Flask"
By Oliver J. Graham.....Chicago

"Impression Taking"
By John H. Hospers.....Chicago

"Full Denture Construction"
By Lester N. Roubert.....Chicago

"The Use of the Microscope in Dentistry. Illustrating Embryology, Histology, Pathology, Bacteriology, Photomicrography, Micro-Chemistry and Metallurgy."
By Vida A. Latham.....Chicago



Arena, Auditorium, where clinics will be held.

"X-Rays of Oral Surgery Cases"
By Earle H. Thomas.....Chicago

"Some Helpful Suggestions in Prosthesis"
By C. L. Snyder.....Freeport

"Use of Tin and Gold in Young Mouths"
By E. F. Hazell.....Springfield

"Absorbent Cotton and Dental Medicaments"
By Harry F. Lotz.....Joliet

"Artificial Denture Construction"
By Rupert E. Hall.....Chicago

"Root-Canal Technic"
By W. E. Snow.....Chicago

"An Easy Process in Gold Inlay Work, of Taking Wax Impressions, Carving Wax Model, Casting Gold Inlays; Pinlays, Pinlocks and Bridge Abutments; and How and Where to Use Them in the Conservation of Pulps"
By P. A. Pyper.....Pontiac

"Some Important Steps in Successful Denture Construction"
By V. P. Perisho.....Streator

"Lingual Bar and Clasps"
By H. F. Methven.....Chicago

"Removable Bridges Using Cast Clasps and Attachments for Vital Teeth"
By C. W. Peterson and H. L. Lindburg.....Moline

"Fixed Bridge Abutment Pieces, for Vital Teeth, Both Anterior and Posterior"
By R. E. MacBoyle.....Chicago

"Bridge Attachments to Vital Teeth from Operative Point of View"
By Victor T. Nylander.....Chicago

"Early Dental Operating Case with Pearl-Handled Instruments from Museum of Northwestern Dental School"
By W. L. Wylie.....Chicago

"Porcelain Jacket Crowns—from Start to Finish"
By Harris J. Frank.....Chicago

"Stone Removed from Sublingual Duct"
By Thomas White.....Naperville

"The Importance of Absolute Parallelism of Attachments in Modern Removable Bridge-Work"
By H. M. Heggland.....Chicago

"Obtunding Sensitive Dentin in Cavity Preparations"
By W. T. Reeves.....Chicago

"A Method of Using Dowel or Diatoric Teeth for an All-Porcelain Crown"
By Harry J. Combs.....Evanston

"Exhibit of Photographs of Illinois State Dental Society"
By G. H. Henderson.....Chicago

"New Lubricant Used in Connection with Gutta-Percha Cones for Filling Root-Canals"
By L. H. Arnold.....Chicago

"Filling Root-Canals"
By Edgar D. Coolidge.....Chicago
J. R. Blayney.....Chicago
Robert E. Wilder.....Evanston

"Radiographs of a Compound Fracture of the Mandible, Together with Models and Splints Used in Reduction of the Fracture"
By A. E. DeRiemer.....Chicago

"Gold Inlay Technic Impression Method for Wax Patterns; Low Heat Wax Dissipation"
By Eugene Maginnis.....Chicago

"Construction of Full Dentures from Impression Taking to Completion, Including the Carving and Staining of the Six Anterior Teeth"
By J. H. Kaplan.....Chicago

INDIANA

W. E. Kennedy, Director.....Indianapolis

"Full Dentures Showing Esthetics and Efficiency in Construction"
By M. M. House.....Indianapolis
R. H. Hopkins.....Indianapolis
H. A. Young.....Indianapolis

"Radiographic Diagnosis"
By Earl Brooks.....Noblesville

"Root-Canal Filling"
By Frank A. Hamilton.....Indianapolis

"Porcelain Jacket Crowns"
By J. L. Wilson.....Indianapolis

"Bridge With Pin Retention in Vital Teeth"
By R. M. Hubbard.....Indianapolis

KANSAS

J. F. Kernan, Director.....Wichita

"Kansas Kinks"
By George W. Frank.....Arkansas City

"Closed Mouth Impressions" (Impressions taken with mouth really closed)
By E. J. Cutshaw.....Phillipsburg

"An Accurate Method of Pulp Canal Filling"
By J. Fremont Burkett.....Kingman

"Temporary Plate: Impression Taken and Denture Constructed before Teeth are Removed"
By W. A. Clement and C. M. Rose.....Wichita

"Technic for Three-Quarter Crown"
By Ralfrad Rothschild.....Salina

"Conservative Abutments for Live Teeth in Fixed Bridge-Work"
By Lester D. Mitchell.....Arkansas City

"An Accurate Method of Securing an Inlay by the Indirect Method"
By George E. Weight.....Wichita

"Method of Root-Canal Filling"
By S. S. Noble.....Wichita

LOUISIANA

Thomas M. Terry, Director.....New Orleans

"Porcelain Gum Restoration"
By Edward B. Ducasse.....New Orleans

MINNESOTA

Elmer S. Best, Director.....Minneapolis

1. Anesthesia
2. Oral Diagnosis
3. Periodontia
4. Pediodontia
5. Oral Surgery
6. Orthodontia
7. Ceramics
8. Operative Dentistry
9. Prosthetic Dentistry

NORTH CAROLINA

F. L. Hunt, Director.....Asheville

"Short Bridges, Abutments Fixed and Not Fixed"
By E. G. Click.....Elkin

"Various Uses of Synthetic Porcelain"
By D. B. Mizell.....Windsor

"The Advantages of Certain Technic in Carving Wax Models"
By J. A. McClung.....Winston-Salem

"Removable Bridge-Work, Using the Cast Clasps as Abutment Pieces"
By R. W. Malone.....Goldsboro

NORTH DAKOTA

W. E. Hocking, Director.....Devils Lake

"The Correct Technic for the Preparation of an Isotonic Anesthetic Solution; Also Demonstrating the Action of Non-Isotonic Solutions Upon the Blood, Muscles and Nerve Tissue Cells of Living Animals."
By Ira G. Nichols.....Mandan

"Importance of Occlusal Planes and Contact Points on Gold Inlays"
By George P. Jorgenson.....Grand Forks

RHODE ISLAND

Ira B. Stilson, Director.....Providence

"Complete Sterilization, Procedure and Technic in Exodontia and Oral Surgery"
By J. Stafford Conley.....Providence

"Amalgam Restoration"
By Frank P. Duffy.....Riverpoint

"Faulty Technic in Casting and Its Correction"
By J. Fred Keeley.....Fall River

SOUTH DAKOTA

"Some Features of Conductive Anesthesia"
By Ralph H. Fouser.....Salem

TENNESSEE

O. A. Oliver, Director.....Nashville

"Casting Two Abutment Pieces and Constructing Bars on Original Model"
By Joseph A. Gardner.....Memphis

"Porcelain Jacket Crowns"
By Carl W. Hoffer.....Nashville

"The Definite Surgery of Peridontal Lesions"
By Justin D. Towner.....Memphis

TEXAS

J. M. McMinn, Director.....Dallas

"Advocacy of Fixed Bridge-Work"
B. J. P. Arnold.....Houston

"Porcelain Tipped Dummies (Not Final)"
By E. L. Knox.....Dallas

"Cast-Swedged Gold and Aluminum Bases in Full Denture Work"
By J. M. McMinn.....Dallas

UTAH

Victor H. Sears, Director.....Salt Lake City

"Preparation of the Alveolar Ridges for Artificial Dentures"
By Ernest W. Browning.....Ogden
Victor H. Sears.....Salt Lake City

WISCONSIN

Burlington County Dental Society

A. A. Marck, Director.....Burlington

AMALGAM UNIT

"Cavity Technic".....O. H. Mills, A. J. Zimmer, W. E. Dunbar, Jr.

"Matrices".....C. J. Reinardy, A. J. Ketterhagen, W. L. Dunkirk

"Mixing and Packing".....C. E. Bottomley, H. H. Newbury, M. T. Hueber

"Carving and Finishing".....W. L. Hassold, S. C. Goff, F. M. Kyburz

Milwaukee County Dental Society

George P. Brenner, Director.....Milwaukee

DENTURE UNIT

"Impression Trays and Mixing Plaster: Correct Proportions and Consistency".....A. A. Jennings, C. J. Jane

"Compound Technic—Full Upper and Lower".....C. E. Gage, P. G. Hirtz

"Plaster Impressions and Casts in Spences Plaster and Calsilith".....William Hopkinson, J. W. Lewis

"Upper and Lower Cast Mounting on Articulator".....Theodore Kuechle

"Upper and Lower, Correctly Articulated, Carved, and Tin-foiled, Ready for Flask".....V. A. Smith, C. T. Rosenbaum

"Upper and Lower Properly Flasked, Rubber Packed, Correct Vulcanization, Etc.".....A. J. Richter, J. J. Ruhland

"Re-fit Upper Denture".....P. W. Rood

"Exhibit of Practical Full Denture Cases".....George P. Brenner

PORCELAIN UNIT

(Jacket Crown and Porcelain Root Technic)

H. M. Uebele, Director.....Milwaukee

"Root Preparation".....H. F. Thiel
"Impression Taking".....F. W. Heinemann
"Model Making".....W. L. Seng
"Burnishing".....J. J. Wright
"Porcelain Baking".....H. M. Uebele
"Baking Roots on Facings".....A. C. Sandner

GOLD INLAY UNIT

(Showing the Technic of Cavity Preparation, Pattern Making, Investing, and Casting)

H. G. Morton, Director.....Milwaukee

T. L. Gilbertson, W. H. Schaller, F. W. Heinemann, J. G. Schottler, Harry P. Jahn, C. M. Schwendener, Harry G. Morton, N. E. Uelmen

LOCAL ANESTHESIA UNIT

Roy S. Hopkinson, Director.....Milwaukee

Table No. 1
Pharmacology.....George W. Wilson, J. J. Wright

Table No. 2
Osteology.....L. E. Washburn
(Anatomical Landmarks Important in Local Anesthesia)

Table No. 3
Topography.....William Hopkinson

Table No. 4
Neurology.....Edward C. Voelker

Table No. 5
Technic of Injections and Summary.....Roy S. Hopkinson

BRIDGE-WORK UNIT

M. H. Mortonson, Director.....Milwaukee

"Technic of Movable-removable Bridge Construction"

M. H. Mortonson	J. C. Mortonson
A. W. Brictson	E. A. Steinhaus
E. W. Blaisdell	F. J. Metzger
E. C. Wetzel	E. G. Kohlsdorf

PARTIAL GOLD PLATE AND CAST CLASPS UNIT

O. G. Krause, Director.....Milwaukee

"The Complete Technic of the Cast Clasp, the Cast Plate, the Assembling of All Parts, and the Taking of Partial Impressions"

P. W. Rood	J. W. Lewis
M. E. Johnson	W. A. McFarlane
E. J. Liebstuck	W. S. Griffiths

PATHOLOGICAL LABORATORY UNIT

Earl Doyle, Director.....Waukesha

"Introductory Remarks Showing the Necessity of Using This Oft Neglected Part of Our Dental Education"

"Technic of Obtaining and Sending Specimen to the Pathological Laboratory"

"Explanation of Laboratory Reports and Indication as to When Such Examination Should Be Made"

(Showing Microscopic Specimen)

E. J. Weaver	H. M. Uebele
Albert Wiebrecht	C. M. Schwendener
W. H. Schaller	Elmer A. Steinhaus
N. E. Uelmen	E. C. Wetzel

Racine County Dental Society

James G. Nelson, Director.....Racine

"Cast Attachments in Bridge-Work"

By Earl Caulkins.....Racine
James G. Nelson.....Racine

Winnebago County Dental Society

OSHKOSH AMALGAM UNIT

M. L. Christensen, Director.....Oshkosh

"Up-to-the-Minute Technic on Amalgam"

J. F. Mortell	J. J. Geary
C. C. Norris	G. A. Stratton
R. J. Chady	J. L. Bender
O. B. Hinz	H. E. Gage

TRANSPORTATION TO THE MILWAUKEE MEETING

Reduced fares will be available to members attending this meeting, from all parts of the United States except the territory of the New England Passenger Association which has refused to grant any reduction in fare.

Summer excursion tickets from principal stations in California will be on sale from June 15 to August 15, and from principal points in Nevada, Oregon, Washington and western British Columbia from June 1 to August 15, to Chicago, at approximately one and one-third fare for the round trip, with return limit three months from date of sale, but not later than October 31.

All other territory (except New England points) has granted to members, and dependent members of their families, a rate of one and one-half fare on the certificate plan. Full fare will be paid on going trip and certificate must be obtained from the agent at the time the ticket is purchased, these certificates to be presented to the indorsing officer at the place of meeting. Certificates which show the purchase of tickets on August 11-17 inclusive, when validated by joint agent at meeting, will be honored for return tickets at one-half fare, if presented to ticket agent not later than August 23, 1921.

Members from New England points may pay one-way fare to New England Passenger Association boundaries, and therefrom avail themselves of the certificate plan arrangements.

COMMITTEE ON TRANSPORTATION,
D. C. BACON, *Chairman*

LIST OF EXHIBITORS

Abbott Laboratories, 4753 Ravenswood Ave., Chicago, Ill.

Adams X-Ray Company, 1940 Maple St., Detroit, Mich.

Julius Aderer, Inc., 47 W. 42nd St., New York, N. Y.

Alkalol Co., Taunton, Mass.

American Cabinet Co., Two Rivers, Wis.

American Surgical Specialty Company, 6 E. Lake St., Chicago, Ill.

W. V-B. Ames Co., Fremont, Ohio.

Antidolar Mfg. Co., Springville, Erie County, N. Y.

Anti-Pyorrhea Chemical Co., 401-2 Commercial Bldg., St. Louis, Mo.

Archer Mfg. Co., Inc., Rochester, N. Y.

Claudius Ash & Sons, 1 Union Square, New York, N. Y.

Bacon Mfg. Co., 416 La Salle Bldg., Minneapolis, Minn.

Baker & Co., Inc., Murray and Austin Sts., Newark, N. J.

Belding Bros. & Co., 201 W. Monroe St., Chicago, Ill.

Bethlehem Laboratories, Wilbur Trust Bldg., Bethlehem, Pa.

Frank S. Betz Co., Hammond, Ind.

Blue Island Specialty Co., Blue Island, Ill.

Henry P. Boos Laboratories, 608 Nicollet Ave., Minneapolis, Minn.

Borine Mfg. Co., 551 W. 42d St., New York, N. Y.

Boston Dental Laboratory, Herald Bldg., Boston, Mass.

Harry J. Bosworth Co., 1705 Tower Bldg., Chicago, Ill.

Bristol-Myers Co., 281 Greene Ave., New York, N. Y.

Brophy Dental Mfg. Co., 1865 Ogden Ave., Chicago, Ill.

Buck X-Ograph Co., 4485 Olive St., St. Louis, Mo.

Buffalo Dental Mfg. Co., 587-89 Main St., Buffalo, N. Y.

Campbell Electric Co., Lynn, Mass.

Alexander Cassriel Co., 128 S. Wabash Ave., Chicago, Ill.

L. D. Caulk Company, Milford, Del.

Cellubase Corporation, 12412 Cedar Road, Cleveland Heights, Ohio.

Drs. Christopher & Golbeck, 339 S. Wabash Ave., Chicago, Ill.

A. C. Clark & Co., Grand Crossing, Chicago, Ill.

Cleveland Dental Mfg. Co., Cleveland, O.

Colgate & Co., 199 Fulton St., New York, N. Y.

Columbus Dental Mfg. Co., Wager and Jackson Sts., Columbus, Ohio.

P. N. Condit, 120 Boylston St., Boston, Mass.

Crowley Henes Co., 121 Wisconsin St., Milwaukee, Wis.

Thomas J. Dee & Co., 1010 Mallers Bldg., Chicago, Ill.

Dental Products Co., 5 S. Wabash Ave., Chicago, Ill.

Dental Specialty Co., 1638 California St., Denver, Colo.

Dentists' Supply Co., 220 W. 42d St., New York, N. Y.

Denver Chemical Mfg. Co., 20-24 Grand St., New York, N. Y.

De Sanno & Haskins, 1252 N. Broad St., Philadelphia, Pa.

Detroit Dental Mfg. Co., 40-42 Milwaukee Ave., West, Detroit, Mich.

DeVilbiss Mfg., Co., Toledo, Ohio.

Dresch Laboratories, 622 Madison Ave., Toledo, Ohio.

Eastman Kodak Co., Rochester, N. Y.

Edwards X-Ray Corporation, 111-113 N. New Jersey St., Indianapolis, Ind.

Electro Dental Manufacturing Co., 3269 Arch St., Philadelphia, Pa.

Fellows Medical Mfg. Co., 26 Christopher St., New York, N. Y.

H. Fischer & Co., 705 Lexington Ave., New York, N. Y.

H. G. Fischer & Co., 2335-43 Wabansia Ave., Chicago, Ill.

Flossy Dental Mfg. Co., Evanston, Ill.

Flaherty Mfg. Co., West Bend, Wis.

Friedman Specialty Co., 22 E. Washington St., Chicago, Ill.

Garhart Dental Specialty Co., Hill Bldg., Somerville No. 42, Mass.

Goldsmith Bros. Smelting & Refining Co., Heyworth Bldg., Chicago, Ill.

Machinery Hall, Auditorium (46,800 square feet), best illuminated and ventilated hall in America, to be used for exhibits.

The Halverson Company, 180 N. Dearborn St., Chicago, Ill.

Harvard Company, Canton, Ohio.

Jay E. Healy, 44 W. 44th St., New York, N. Y.

The Heidbrink Co., 420 S. 6th St., Minneapolis, Minn.

Mrs. W. M. Herriott & Son, 237 N. Pennsylvania St., Indianapolis, Ind.

Horlick's Malted Milk Co., Racine, Wis.

Ideal Interchangeable Tooth Co., Boston, Mass.

Industrial Rubber Corporation, Long Island City, N. Y.

International Dental Manufacturing Co., 6 E. Lake St., Chicago, Ill.

J. W. Ivory, 618 Chestnut St., Philadelphia, Pa.

J. F. Jelenko & Co., 1 Union Square, New York, N. Y.

H. D. Justi & Son, 1301 Arch St., Philadelphia, Pa.

K. C. Oxygen Gas Co., 18th and Grand Ave., Kansas City, Mo.

Keasbey & Mattison Co., 222-24 W. Lake St., Chicago, Ill.

W. A. Kelsey, 3535 9th Ave., South, Minneapolis, Minn.

King's Specialty Co., Fort Wayne, Ind.

C. G. King & Co., Providence, R. I.

The Kolynos Co., New Haven, Conn.

Kress & Owen, 361 Pearl St., New York, N. Y.

H. R. Lathrop & Co., 116 Beekman St., New York, N. Y.

Lavoris Chemical Co., Minneapolis, Minn.

Lea & Febiger, 706 Sansom St., Philadelphia, Pa.

Lincoln Dental Mfg. Co., 1600 Chestnut St., Philadelphia, Pa.

Power Litchfield Co., Humboldt, Kan.

Manhattan Coat Factory, 3223 N. Halsted St., Chicago, Ill.

Medical Protective Company, Fort Wayne, Ind.

A. F. Meserve Laboratories, 2251 South Park Ave., Chicago, Ill.

H. A. Metz Laboratories, Inc., 122 Hudson St., New York, N. Y.

Metzan Dental Mfg. Co., 211 E. 62d St., New York, N. Y.

E. C. Miller, D.D.S., Williamsport, Pa.

Milwaukee Dental Specialty Co., 3212 Lloyd St., Milwaukee, Wis.

C. V. Mosby Co., 509 N. Grand Ave., St. Louis, Mo.

Mynol Chemical Co., Real Estate Trust Bldg., Philadelphia, Pa.

Neometric Dental Instrument Co., 7 W. 45th St., New York, N. Y.

J. M. Ney Company, Hartford, Conn.

Novocol Chemical Co., 2923 Atlantic Ave., Brooklyn, N. Y.

M. F. Patterson Dental Supply Co., 141 Wisconsin St., Milwaukee, Wis.

A. E. Peck Mfg. Co., Minneapolis, Minn.

Pelton & Crane, 632 Harper Ave., Detroit, Mich.

Pepsodent Company, 1104 S. Wabash Ave., Chicago, Ill.

Jacob Petry Retainer Co., 2022 Lowrie St., Pittsburgh, Pa.

Charles H. Phillips Chemical Co., 128 Pearl St., New York, N. Y.

Geo. P. Pilling & Son, Philadelphia, Pa.

Prophylactic Tooth Powder, Inc., 38 E. 61st St., New York, N. Y.

Ransom & Randolph Co., Drawer 906, Toledo, Ohio.

Ritter Dental Mfg. Co., 404 West Ave., Rochester, N. Y.

Safety Anaesthesia Apparatus Concern, 1652 Ogden Ave., Chicago, Ill.

Sanitary Cup and Service Co., 189 N. Clark St., Chicago, Ill.

Scanlan Morris Co., Madison, Wis.

Sentanel Remedies Co., Masonic Temple, Cincinnati, Ohio.

Shafer-Pierce Co., 460 Washington Bldg., Madison, Wis.

Shepherd Chemical Co., 231 N. Wells St., Chicago, Ill.

Lee S. Smith & Son Mfg. Co., Pittsburgh, Pa.

Solvite Laboratories, 6219 S. Halsted St., Chicago, Ill.

Specialty Mfg. Co., 15 Spruce St., New York, N. Y.

Spyco Smelting and Refining Co., Syndicate Bldg., Minneapolis, Minn.

I. Stern Dental Supply Co., 1 Union Square, New York, N. Y.

I. Stern & Co., 104 W. 116th St., New York, N. Y.

Stratford-Cookson Co., Philadelphia, Pa.

Samuel G. Supplee & Co., 1 Union Square, New York, N. Y.

The Thoro Corporation, 217 W. Huron St., Chicago, Ill.

Toledo Technical Appliance Co., 2226 Ashland Ave., Toledo, Ohio.

Twentieth Century Dental Broach Co., 51 E. 42d St., New York, N. Y.

Universal Dental Co., Southeast Corner 33d and Columbia Ave., Philadelphia, Pa.

Dr. F. H. Vallender, Boston, Mass.

Victor X-Ray Corporation, 236 S. Robey St., Chicago, Ill.

L. P. Wagner, General Delivery, Milwaukee, Wis.

Wappler Electric Co., 162 Harris Ave., Long Island City, N. Y.

Washington Drug Products Co., 29 W. 125th St., New York, N. Y.

Weber Dental Mfg. Co., Canton, Ohio.

H. G. Weeks Mfg. Co., Hamilton, Ohio.

Weissfeld Brothers, 474 Broadway, New York, N. Y.

Wells Building Drug Co., 122 Wisconsin St., Milwaukee, Wis.

R. J. Wenker Dental Mfg. Co., 425 E. Water St., Milwaukee, Wis.

H. J. Werner, 3010 St. Paul Ave., Milwaukee, Wis.

Western Laboratory of Dental Ceramics, 732, 190 N. State St., Chicago, Ill.

The S. S. White Dental Mfg. Co., 211 S. 12th St., Philadelphia, Pa.

H. B. Wiggin's Sons Co., Bloomfield, N. J.

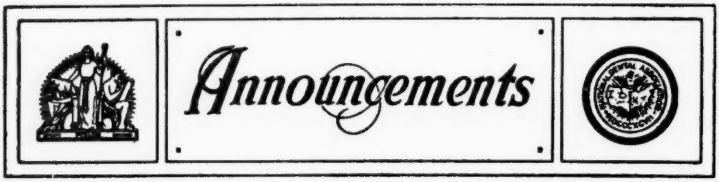
Wilmot Castle Co., Rochester, N. Y.

Wisconsin Electric Co., 8334 16th St., Racine, Wis.

John H. Wood Co., 126 Market St., Philadelphia, Pa.

W. F. Wood Co., 120 Wisconsin St., Milwaukee, Wis.

Wright Dental Supply Co., Milwaukee, Wis.



CALENDAR OF MEETINGS

NATIONAL SOCIETIES

National Dental Association, at Milwaukee, Wisconsin, August 15-19.

National Society of Denture Prosthetists, at Milwaukee, Wisconsin, August 1-13, Hotel Medford.

National Association of Dental Examiners, at Milwaukee, Wisconsin, August 15, Hotel Pfister. T. A. Broadbent, Secretary-Treasurer, 25 E. Washington Street, Chicago, Ill.

Psi Omega Fraternity, Biennial Grand Chapter, August 10, and National Alumni Chapter, August 15, at Milwaukee, Wisconsin Hotel. M. M. Printz, Supreme Councillor, 25 East Washington Street, Chicago, Ill.

Xi Psi Phi Fraternity, Alumni Association, August 15, at Milwaukee, Wisconsin Hotel. J. Emmett Northcutt, Secretary, St. John and Elmwood Avenue, Kansas City, Mo.

Delta Sigma Delta Fraternity, August 15, at Milwaukee, Hotel Pfister. R. Hamill D. Swing, Supreme Scribe, 1623 Walnut Street, Philadelphia, Pa.

Association of Military Dental Surgeons, at Milwaukee, August 16 and 17. G. H. Cassady, Secretary-Treasurer, Presidio, San Francisco, Cal.

Dental Veterans of the World War, at Milwaukee during meeting of the National Dental Association. Harry L. Hosmer, Secretary, Detroit, Mich.

American Society of Exodontists, August 11, 12, 13, at Milwaukee. F. F. Molt, Secretary, 25 E. Washington Street, Chicago, Ill.

American Dental Library and Museum Association, August 15 and 17, at Milwaukee. B. W. Weinberger, Secretary, 40 E. Forty-first Street, New York City.

American Institute of Dental Teachers, third week of January, 1922, at Montreal, Quebec. Abram Hoffman, Secretary, 381 Linwood Avenue, Buffalo, N. Y.

STATE SOCIETIES

June

California, at San Francisco (June 27 to July 2).

California (Southern) at Los Angeles (20, 21, 22).

Florida, at Gainsville (14-17).

Georgia, at Macon (8, 9, 10).

Idaho, at Boise (June 27 to July 2).

Maine, at Bar Harbor (21, 22, 23).

New Jersey, at Atlantic City, Steel Pier (1, 2, 3).

New Mexico, at Albuquerque (20-25).

North Carolina, at Charlotte (28-30).

South Carolina, at Greenville (14, 15, 16).

Utah, at Salt Lake City (20-25).

July

Washington, at Vancouver, B. C.

August

Wisconsin; no state meeting because of the National Dental Association meeting in Milwaukee.

October

Virginia, at Richmond (11, 12, 13, 14).

December

Ohio, at Columbus (6, 7, 8).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Arkansas, at Little Rock, Hotel Marion, June 27, 28, 29. H. J. Green, Secretary, Paragould Trust Company Building, Paragould, Ark.

Delaware, at Wilmington, Municipal Building, Tenth and King Streets, July 13 and 14. W. S. P. Combs, Secretary, Middletown.

Georgia, at Macon, June 8, 9, 10. D. D. Atkinson, Secretary, Brunswick.

Idaho, July 12. Paul Davis, Director, Bureau of License, Boise.

Maine, at Augusta, State House, July 7, 8. 9. Henry Gilman, Secretary, 192 State Street, Portland.

Massachusetts, at Boston, June 16, 17, 18, 20, 21, 22, 23. J. N. Carriere, Secretary, Fitchburg.

Michigan, at Ann Arbor, June 20-25. E. O. Gillespie, Secretary, 1541 David Whitney Building, Detroit.

Montana, at Helena, July 11. Frank J. Bell, Secretary, P. O. Box 425, Billings.

New Jersey, at Trenton, Second Regiment Armory, June 27-July 1. John C. Forsyth, Secretary, 429 E. State Street, Trenton.

North Dakota, at Fargo, July 12. W. E. Hocking, Secretary, Devils Lake.

Rhode Island, at Providence, State House, June 28, 29, 30. Albert L. Midgley, Secretary, 315 Butler Exchange Building, Providence.

South Dakota, at Sioux Falls, June 28, 29, 30. L. R. Walston, Secretary, Redfield.

Texas, at Dallas, June 20-24. Harrison B. Cave, Secretary, Wilson Building, Dallas.

Vermont, at Montpelier, State House, June 27, 28, 29. Harry F. Hamilton, Secretary, Newport.

West Virginia, Charleston, June 28, 29, 30. R. Mason Hite, Secretary, Mannington.

Wyoming, at Cheyenne, June 28-July 2. Peter Appel, Jr., Secretary, P. O., Box 643, Cheyenne.

STUDY CLUBS AND OTHER SOCIETIES

Alumni Association of the International School of Orthodontia, July 14 and 15, at Hotel Baltimore, Kansas City, Missouri. Secretary, Sidney S. Block.

Pennsylvania Society of Dental Surgeons, October 12-15, Philadelphia, Pa.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The Delaware State Board of Dental Examiners will hold their next examination in Wilmington, Delaware, Municipal Building, Tenth and King Streets, July 13 and 14, 1921. For further information apply to

W. S. P. Combs, *Secretary*
Middletown, Del.

BOARD OF DENTAL EXAMINERS OF GEORGIA

This board will meet in Macon, Georgia, June 8, 9, 10, 1921, for the purpose of passing upon those who apply for license to practice in the state.

D. D. Atkinson, *Secretary and Treasurer*
Brunswick Ga.

STATE BOARD OF DENTAL EXAMINERS OF NORTH DAKOTA

The next meeting of the State Board of Dental Examiners will be held in Fargo, beginning at nine o'clock Tuesday morning, July 12. All applications must be filed with the secretary at least ten days before the examination. For further information write to

W. E. Hocking, *Secretary*
Devils Lake, N. D.

MICHIGAN STATE DENTAL EXAMINATION

The next examination for candidates to practice dentistry in this state will be held by the Dental Examining Board at Ann Arbor the week of June 20-25, inclusive. The examination starts at eight o'clock sharp on the first day. The candidates must have credentials in the hands of the secretary ten days previous to this examination. For all further information, application blanks, etc., address

E. O. Gillespie, *Secretary*
1541 David Whitney Bldg., Detroit, Mich.

MASSACHUSETTS STATE DENTAL EXAMINATION

The Massachusetts Board of Dental Examiners will hold a meeting for the examination of candidates June 16, 17, 18, 20, 21, 22 and 23, 1921, in Boston, Massachusetts. All candidates must file their applications at least ten days before date of examination. For further details, application forms, etc., address

J. N. Carriere, *Secretary*
352 Main St., Fitchburg, Mass.

THE AMERICAN SOCIETY OF EXODONTISTS TO MEET IN MILWAUKEE

The American Society of Exodontists will hold their annual meeting in Milwaukee, Wisconsin, August 11, 12, and 13, 1921. An excellent program and interesting clinics will be presented, with one session devoted to a joint meeting with the American Society of Dental Prosthetists.

The members of this Society have been invited to spend the two days antedating the regular meeting—August 9 and 10, at Rochester, Minnesota, where a program will be presented by staff members of the Mayo Clinic.

Special Pullman arrangements will be provided from Rochester, arriving in Milwaukee early Thursday morning.

F. F. Molt, *Secretary*
25 E. Washington St., Chicago, Ill

ALUMNI ASSOCIATION OF THE INTERNATIONAL SCHOOL OF ORTHODONTIA

There will be a meeting of the Alumni Association of the International School of Orthodontia at Hotel Baltimore, Kansas City, Missouri, July 14 and 15, immediately following the annual session of that school.

A cordial invitation is extended to all dentists who are interested in orthodontia to meet with us.

SIDNEY S. BLOCK, *Secretary*

DENTAL CORPS

Major Albert S. Cumming, having been found by an Army retiring board incapacitated for active service on account of disability incident thereto, his retirement from active service is announced; proceed home.

Major Earl N. McCue, honorably discharged.—*Army and Navy Register*, April 30, 1921.

Major Oscar G. Skelton, upon arrival in United States, will report to 8th corps area for assignment to duty and station.

Major Harry E. Smalley from duties at Jefferson Barracks, Mo., to Fort Myer, Va., for duty, relieving Captain William B. Caldwell, who will repair to Walter Reed General Hospital, D. C., for duty.

The following, upon arrival in United States, to stations indicated for duty: Captains Horace R. Finley, Walter A. Rose, John N. White, Camp Jackson, S. C.; Captain Wayne W. Woolley, Camp Grant, Ill.—*Army and Navy Register*, May 7, 1921.

Major Richard B. Clark report to retiring board at Fitzsimons General Hospital, Denver, Colo., for examination.

Captain Albert L. Alexander from duty at Lakehurst Proving Ground, N. J., to Metuchen, N. J., Raritan Arsenal for duty.

Captain George J. Krakow, having been found by an Army retiring board incapacitated for active service on account of disability incident thereto, his retirement from active service is announced; proceed home.—*Army and Navy Register*, May 14, 1921.

Resignation by Major William Mann, to take effect at Honolulu, H. T., is accepted.—*Army and Navy Register*, May 21, 1921.

DENTAL RESERVE CORPS

Captain William P. Katz proceed home and stand relieved from active duty.—*Army and Navy Register*, May 14, 1921.

PATENTS OF INTEREST TO DENTISTS

1329837, Dental floss-tape lip-protector, Jacob Hook, Reno, Nev.

1329980, Toothbrush, Nicholas Laudiero, New York, N. Y.

1329843, Device for mixing and kneading amalgam from mercury and alloy, Charles W. Meguiar, Sonora, Ky.

1330525, Rotary toothbrush, Jacob Goldstein, West Hazelton, Pa.

54425, Design, dental flask, Theodore G. Lewis, Buffalo, N. Y.

1331302, Apparatus for trimming odontological casts, Vincent S. Wickham, Worcester, Mass.

1331974, Prosthesis, Asmus C. S. Angel, Copenhagen, Denmark.

1331805, Syringe, Albert Chance, Philadelphia, Pa.

1332170, Dental floss holder, William T. Elzinga, Mill Valley, Cal.

1331660, Dental casting machine, Morton H. and J. C. Mortonson, Milwaukee, Wis.

Copies of above mentioned patents may be obtained for twenty-five cents each, by addressing John A. Saul, Solicitor of Patents, Fendall Building, Washington, D. C.

CLASSIFIED

WANTED—Dentist wants position with ethical practitioner in Los Angeles or San Diego, not yet licensed. Prefer place where partnership or entire business can be bought later. Best references. Married man. Address J823, care The National Dental Association, 127 North Dearborn Street, Chicago, Ill.

WANTED—Dentist, 28, now practicing in Minnesota, desires position with ethical practitioner in or about New York City. Experienced and capable. Good personality. Licensed in New York. Available in a few months. Address J835, care The National Dental Association, 127 North Dearborn St., Chicago, Ill.

FORSYTH-TUFTS TRAINING SCHOOL FOR DENTAL HYGIENISTS.

Term begins October 3, 1921

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